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Prepared for MAINTENANCE POLICY AND ENGINEERING DIVISION Naval Air Systems Command Washington, D. C. 20361

REVISION A SEPTEMBER 1979

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AIRCRAFT MAINTENANCE EXPERIENCE DESIGN HANDBOOK

VOUGHT CORPORATION DALLAS, TEXAS

REVISION A SEPTEMBER 1979

Prepared for

MAINTENANCE POLICY AND ENGINEERING DIVISION Naval Air Systems Command Washington, D. C. 20361

REVISION A TO AIRCRAFT MAINTENANCE EXPERIENCE DESIGN HANDBOOK

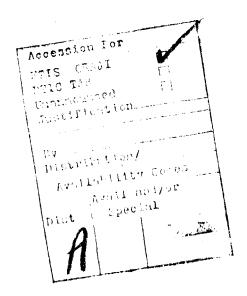
Revision A adds scheduled inspections and other support actions to the Aircraft Maintenance Experience Design Handbook. Section 3.0 has been revised and Sections 5.22 thru 5.26 have been added.

REMOVE PAGES: V thru XI, 3-1 thru 3-17, 5-1, 5-2 and Reference 3

INSERT PAGES: V thru XI, 3-1 thru 3-18, 5-1, 5-2, 5-129 thru 5-190, Reference

All revisions are indicated by a black vertical line in the right/left margin on the page which the change appears. Revised pages without indicated change marks are spill over due to the report being prepared by automatic processing. Fages 5-129 thru 5-190 are new additions to the report.

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three parts. Parts I and II addressing maintenance at both the Organizationa and Intermediate levels while Part III is primarily a discussion of component installations at the Organizational level. Part I contains a description of the technical analysis leading to the development of the Maintainability Index Model (MIM). Part II provides the instructions for the application of the model for establishing maintainability requirements and evaluating maintainability predictions. Part II also provides maintainability data on various aircraft and their systems which will aid the user in making procedure adjustments for special aircraft applications. Part III presents quantitative and qualitative information concerning the maintainability attributes of selected maintenance significant component installations. Those installation characteristics that have proven to be effective in expediting or simplifying maintenance are highlighted.

The procedures are presented in a sequence to permit analysis for the total aircraft, or down to aircraft system or component level. Design and maintenance engineers can use this information for analyzing new systems and components or those being considered for change.

AIRCRAFT MAINTENANCE EXPERIENCE DESIGN HANDBOOK

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Separate listings of the Illustrations and Tables contained in the Handbook are not provided due to the repetitive nature of the titles and the voluminous extent of the individual listings. To insure completeness of the text, the inclusive numbers for each section are included. With one exception, (Section 5.0), they are numbered sequentially within each section and all numbers are prefixed with the section or appendix identifier in which they appear.

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	Attachment 2	1 inclusive
	Appendix D	D-1 through D-2
	Appendix E	E-1 inclusive

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3.0 MAINTAINABILITY INDEX MODEL (MIM)

The prediction tool used to determine two-digit WUC maintenance values involves the use of a Maintainability Index Model (MIM). The MIM projects realistic maintainability estimates for Navy Fighter, Attack and ASW aircraft for use during conceptual and development design. The model is based on regression analysis techniques which relate historical maintenance data (MMH/FH and MA/FH) to design and performance parameters, i.e. weight, thrust, speed, etc. This technique was used successfully by the Northrop Corporation in a report on maintenance characteristics of United States Air Force tactical fighter aircraft (Reference 11). Techniques from that study were modified and expanded to include additional maintenance data. The result is that the MIM and its complete set of index equations provides the Navy with a unique capability to rapidly evaluate and predict new aircraft maintenance requirements.

3.1 GENERAL DESCRIPTION

This section discusses the procedure used to predict MMH/FH, MA/FH, MMH/MA, EMT/MA and MEN at Organizational ("O") and Intermediate ("I") levels for a 3-M (Class 1) and FSE (Class 3) environment. A logic flow diagram depicting the derivation and operation of the MIM is presented in Figure 3.1. Section 3.0 also contains sample calculations and model validation.

3.2 MCDEL DERIVATION

The maintainability characteristics of tactical fighter/attack aircraft are directly related to design and performance parameters (Reference 10). Selection of these parameters along with a valid maintenance data base was the first step in developing the MIM.

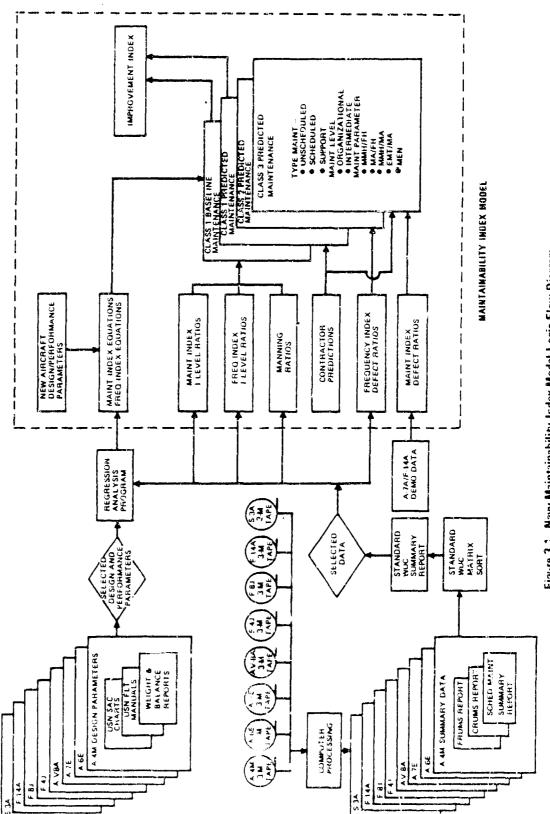
3.2.1 Aircraft Parameters

It is recognized that increased performance of modern aircraft results in increased maintenance requirements. Although the increase in maintenance is probably due to increasing system complexity, accurate measure of complexity is difficult to derive and to apply consistently. Through considerable research and trial and error, a viable procedure which can accurately and consistently measure system complexity was developed. This procedure, which is used in this text, involves the use of design and performance parameters to establish a relationship between increases in complexity and maintenance requirements.

The Fighter/Attack/ASW aircraft considered in the correlation analysis were chosen because they provided a broad historical data base. Availability of maintenance data and design parameters were the main factors in the selection of these late model aircraft. Listed below are the aircraft used in the two-digit WUC analysis by type aircraft and year of first Fleet delivery:

A-414	1971	F-4J	1966
A-6E	1971	F-8J	1968
A-7E	1969	F-14A	1973
AV-8A	1971	S-3A	1974

These aircraft possess the range and variation of design characteristics necessary to produce valid estimating relationships. The empty weight of the



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Figure 3.1 Navy Maintainability Index Model Logic Flow Diagram

3

aircraft range from 10,400 pounds to 38,200 pounds; the maximum speed ranges from 400 to 1300 knots and thrust ranges from 11,200 pounds to 41,800 pounds. Selected aircraft are evenly distributed with respect to crew size (four single-seat, three two-seat and one four-seat) and number of engines (four single-engine and four twin engine).

Table 3.1 presents a list of those parameters that were found to be most representative of an aircraft's design characteristics and were proven to be statistically valid. Values shown were extracted from the following documents:

- o USN Standard Aircraft Characteristics Charts
- o Weight and Balance Reports generated by each contractor

Other aircraft parameters that were considered, but rejected by the regression analysis program because of poor correlation include:

- o Weight, Environment Control System (ECS)
- o Weight, Engine
- o Speed, Minimum Landing
- o Thrust per Aircraft
- o Number of Fuel Tanks
- o Fuselage Volume
- o Service Ceiling
- o Maximum Payload
- o Utilization Rate
- o Weight, Useful Load

3.2.2 Two-Digit Work Unit Code (WUC) Data Base

A 4 to 12 month FMSO data base was selected for use in the system analysis. Raw 3-M data tapes obtained from FMSO were processed by computer programs into four output reports: three concerning unscheduled maintenance and one concerning scheduled maintenance. Each of the three unscheduled reports identified one of the three classes of maintenance established in the previous section, paragraph 2.3. The scheduled report identified scheduled maintenance for the three classes of maintenance in one report.

- FRUMS Report. The Fleet Reported Unscheduled Maintenance Summary (FRUMS) Report depicted Class 1 maintenance. It identified historical maintenance data as reported in an operational environment.
- CRUMS Report. The Contractor Responsible Unscheduled Maintenance Summary (CRUMS) Report was derived from the FRUMS Report with Navy responsible malfunctions (Table 2.2) deleted. CRUMS data depicted Class 2 maintenance.
- O CCUMS Report. The Contractor Controllable Unscheduled Maintenance Summary (CCUMS) Report was derived from the CRUMS Report with Navy controllable maintenance time (Figure 2.4) deleted. CCUMS data depicted Class 3 maintenance.
- o <u>SCHED Report</u>. The Scheduled Maintenance Summary Report was derived from the raw 3-M data tapes. It identified scheduled maintenance and support by all three classes of maintenance.

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Table 3.1 Design Characteristics - Navy Fighter/Attack/ASW Aircraf:

AIRCRAFT PARAMETER	SYMBO!	UNITS	A.M	A 6E	A.7E	AV-8A	F 43	F-8.	F-14A	S.3A
AREA, FUSELAGE WETTED	FLISWET	103 612	6407	900	0.00					
AREA WING	V 200 V 75	.03 5 7 2	1000	30.5	0.743	200	7 7	1980	3	8
ALINII GOMEO VENINIA	2000		3	675.0	0.375	0.20	0.530	0.375	999.0	0.598
	0 0		-	-	ɔ	-	0	c	ū	-
I DE CONTACT LA TEN CONTROL	×BLC		0	•	0	0	-	-	0	G
CHEMSIZE	CHEW		_	~	-		ćų		3	4
DEASITY	DEN	118/813	17.45	18.05	19.89	17.91	21.56	18.62	्र च	3
DHAC CHUIE :	KCHUTE	,-	_	o	0	0	-	0	0	0
FUEL CAPACITY, INTERNAL	FUEL	10° GAL.	0030	2.344	1476	0.758	1 998	1.348	2.362	1.933
GENERATOR ELECTRICAL POWER	GENKVA	10 ² KVA	0.200	0090	0.250	0.120	0.600	0.250	1.269	500
GUN FACTOH:	KGUN	_	_	C	-	_	o	348		٠
KINETIC ENEHGY (WTLAND X VMIN2)	X.	109 LB KN2	0.209	6.347	0.408	Z	0 656	0.380	. 65.3	0 360
LENGTH, FUSELAGE	FUSIEN	102 6 5	0.413	0.647	1300	0.455	, ,			
NUMBER OF ENGINES	ENGOTY		-		2	G + 50	200	2 2 3		0.533
NUMBER OF PYLONS	PYLGIY	_	· ທ	• 40	- uc		4 (7	- 4	v q	٧ (
SURTIE LENGTH	SL	- HK	1 55	1.83	1.73	1.05	, 86	1.36	. 26	268
SPEED, MAX AT ALTITUDE	VMAX	10 ³ KN	0.537	0 490	909:0	0.525	1.230	0.989	1.314	0.410
SPEED, MIN CAHRIER APPROACH	N N	10 ³ KN	0130	0110	0.139		0 136	0.130	0.122	960 0
THHUST PEH ENGINE	THHUST	10 ³ L6	11.2	6.9	15.0	20 9	17.9	19.6	20.9	9.275
THRUST/WEIGHT BATIO	W/1	_	1 076	0.715	0.793	1.741	1.162	0.990	1,094	0.697
VOLUME, FUSELAGE	FUSVOL	10 ³ F.T	0.596	1.440	096.0	0.676	1.428	1.063	3.340	1.780
WEIGHT, AVIORICS INSTALLED	WIAVIN	10 ³ LB	0.612	2.329	1.347	0.590	2.641	0.819	3.039	4,223
WEIGHT, AVIONICS UNINSTALLED	WTAVUN	103 LB	0.5:3	1.920	1.185	C 450	699	0.711	2.422	3 240
WEIGHT, COMBAT	WTCOM	103 LB	176	45.5	25.9	195	41.7	26.8	49.5	38.2
WEIGHT, EMPTY	WTMT	81 ₆ 31	10.4	26.0	18.9	12.0	30.8	8.8	38.2	26.6
WEIGHT, LANDING CLEAN	WTLAND	10 ³ LB	12.4	28.7	21.1	13.0	35.5	22.5	84.6	28.9
WEIGHT, MAX TAKEOFF	WTMXTO	10 ³ LB	24.5	60.4	420	24 6	5,6.0	3	77.6	53.5
WING SWEEP .	KWING	pr.w	0	0	0	0	9 0	0	· -))
"1 IF APPLICABLE, OIF NOT										

3-4

Data from these reports were put into a Standard WUC Matrix (Appendix B) and programmed into a Standard WUC Summary Report (Appendix A). Identification of the time frame for the FMSO data base by type aircraft and corresponding flight hours is presented in Table 3.2.

TABLE 3.2 MIMIDATA BASE

AIRCRAFT	TIME PERIOD	MONTHS	FLT HRS
A-4M	DEC 75 - MAR 76	4	7,160
A-6E	DEC 75 - MAR 76	4	19,802
A7E	JAN 75 - DEC 75	12	106,225
AB-VA	DEC 75 - MAR 76	4	5,944
F-4J	DEC 75 - MAR 76	4	26,238
F-8J	JAM 73 - AUG 73	8	14,087
F-14A	DEC 75 - APR 76	5	12,133
S-3A	JAN 75 - DEC 75	12	22,820

Selection of the two-digit WUC data base differed from the five-digit WUC data base because of data availability. The 4 to 12 month data base was readily available at the start of this Handbook from a previous Vought Research and Development study. Acquisition of a more current and larger data base was originally planned but had to be rejected in order to insure completion of this Handbook in a timely manner.

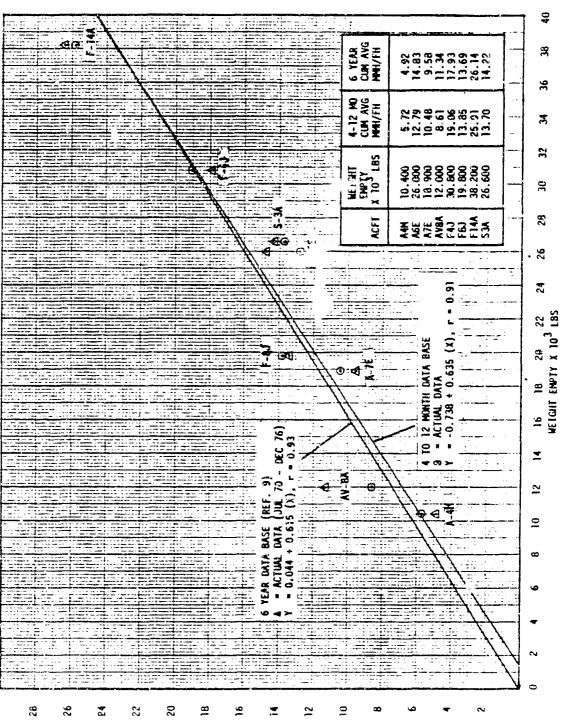
To verify that the 4 to 12 month data base was representative of mature aircraft in an operational environment, a correlation test was performed which compared sample data with a larger six year data base (Table E-1 of Appendix E). The test was made using total weapon system unscheduled MMH/FH (WUC 11-97) as a function of empty weight, one of the primary aircraft parameters that effects maintenance. Results indicate that the 4 to 12 month data base was representative of a six year data base when taken collectively over the eight aircraft. Figure 3.2 shows the results of this correlation.

A slightly lower degree of confidence existed at the system level where more pronounced variations in system maintenance occur as a function of time. However, the RFP requirements are made at the total weapon system level and not at each two-digit WUC. Accuracy of system level predictions need not be exact as long as the predictions are in the "balipark" and their summation results in realistic weapon system estimates. The 4 to 12 month FMSO data base used provided this required accuracy.

3.2.3 Standard Work Unit Codes

Individual aircraft WUC's were converted to a Standard WUC format based on guidelines presented in MIL-STD-780 (Reference 14) and NAILSC Equipment Cross-Index Program (ECIP), (Reference 12). This was necessary to insure an adequate two-digit system level comparison among the different aircraft. An example of the variation in aircraft WUC systems is the Fuel Quantity Indicating Subsystem. The A-4M, A-7E, and F-4J list the Fuel Quantity Indicating Subsystem in the Fuel System (WUC 46), while the A-6E, AV-8A, F-14A and S-3A list it under Instruments

FIGURE 3.2 DATA BASE CORRELATION



3M REPORTED UNSCHEDULED MMH/FH - 0 & I LEVEL

3-8

(WUC 51). Furthermore, MIL-STD-780 lists fuel quantity under WUC 51 while ECIP lists it under WUC 46. Differences such as these are resolved by using MIL-STD-780 as preferred. Appendix B presents a Standard WUC Matrix developed specifically for this Handbook. Standard WUC's are presented to the third digit for the eight Navy aircraft discussed in the system analysis.

The establishment of standard codes for support actions was based on Support Action Codes defined in Reference 18. A further breakdown of these basic codes to the third digit was made using a local command bulletin (Reference 31). A review of the 3-M data indicates most commands are using this bulletin to identify manhours expended in these specific categories of support type work. All total, forty-five work unit and support action codes were condensed into thirty-two standard codes Condensed groupings were necessary to permit a valid statistical analysis of the data.

3.3 MAINTENANCE INDEX ESTIMATING RELATIONSHIPS

The MIM uses a set of estimating relationships called Maintenance Index (MI) equations developed through regression analysis techniques. These equations are used to determine system Class 1 Organizational level MMH/FH as a function of applicable aircraft design and performance parameters.

A statistical ranking order was used to identify those aircraft parameters that reflect the highest coefficient of correlation and the lowest Standard Error of Estimate(S) (References 5, 10). Parameters were selected based on several factors: (1) the most statistically valid parameter. (2) the most valid aircraft parameter and (3) the selection of two parameters for multiple regression. This approach resulted in a set of equations which provided good correlation with actual data. An example of the statistical approach for determining MI equations is presented in the following paragraph.

3.3.1 Statistical Airframe/Fuselage Maintenance Manhours per Flight Hour (MMH/FH)

Statistical Airframe/Fuselage (WUC 11, 12) MMH/FH at the Organizational level is estimated by Equation (Eq.) 3.1. Data used in its derivation and equation results are shown in Table 3.3.

MI = -0.2180 + 0.5692 ln (WTMT) - 0.8394 ln (VMAX) Eq. 3.1

r = 0.97

S = 0.17

 $2S = \pm 0.34$

^{1. 11, 12, 13, 14, 23, 24, 27, 29, 41, 42, 44, 45, 46, 47, 49, 51, 56, 57, 62, 63, 64, 65, 66, 67, 69, 71, 72, 73, 74, 75, 76, 77, 91, 93, 96, 97, 01, 02, 03, 04, 05, 06, 07, 08, 09.}

^{2. 11/12, 13, 14, 23, 24, 29, 41, 42, 44, 45, 46, 47, 49, 51, 56, 57, 60, 71/72/73/74, 75, 76, 9, 01, 012, 016, 02, 03}C, 03D, 03G, 03S, 03Z, 04, 05.

TABLE 13 AIRFRAME/FUSELAGE ACTUAL AND EQUATION MMH/FH

	WTMT	1	MMH/#H	
ACFT		VMAX	ACTUAL	EQUATION
A-4M	10.4	0.537	0.400	0,593
A-6E	26.0	6.496	1.011	1.037
A-78	18.9	0.506	1.071	0.383
AV-BA	12.0	0.525	0.741	0.655
F-4.1	30.8	1.230	2.075	1.907
F-BJ	19.8	0.989	1,499	1,472
F-14A	38.2	1.314	1.902	2.084
S-SA	26.6	0.410	0.834	0.901

The following definitions are presented to provide additional insight into the nomenclature used:

- O <u>Maintenance Index (MI)</u> is defined as the amount of MMH/FH for the given system as measured at the Organizational level.
- o <u>Weight Empty (WTMT)</u> is one of the applicable aircraft parameters for this system as measured in thousands of pounds. Care should be taken when solving the MI equation insuring that the proper decimal point location is observed.
- o <u>Maximum Speed (VMAX)</u> is the second applicable parameter for this system as measured in thousands of knots. Correct decimal point location must be observed when solving the MI equation.
- o <u>Correlation Coefficient (r)</u> is defined as the relative measure of sensitivity between the dependent variable and the independent variable as measured from 0 to 1. The higher the coefficient, the closer "r" approaches 1, the better the data fit. Some systems required numerous regression programs to be run in order to achieve the highest "r" value possible. Values between 0.95 and 0.99 indicate a very high degree of correlation.
- o Standard Error of Estimate (S) measures the average amount of "...dispersion of the Y...[values] away from the line of relationship between the X and Y...[variables]...3". The standard error also serves to measure the amount of error in an individual estimate. Assuming that errors conform to a normal distribution, 95% of the errors would fall within ±2 standard errors of the predicted value. Thus a 95% confidence level can be found by using ±2S which for this example is ±0.34 MMH/FH.

Figure 3.3 presents a complete list of the system Maintenance Index equations developed for this Handbook. Aircraft parameter symbols listed are defined in Table 3.5. A graphical presentation of each MI equation is presented in Section 5.0.

The predicted value calculated by each MI equation is a "baseline" estimate based on the maintainability characteristics of existing inventory aircraft. For a new weapon system, a "predicte ' estimate made by the contractor should be less than the "baseline" estimate depending on the additional maintainability features implemented in the design. The measurement of the delta improvement is discussed in paragraph 3.5.3.

^{3.} H. L. Balsley, <u>Statistical Method</u>, Littlefield, Adams and Co., p. 179.

STU	SYSTEM	MAINTENANCE INDEX EQUATIONS
11,12	AIRFRAME/FUSELAGE	MI =0.2180 + 0.5692 in (WTMT) + 0.8394 (n (VMAX)
13	LANDING GEAR	MI = 0.1738 + 0.0241 (WTLAND)
14	FLIGHT CONTROLS	MI = -0.3963 + 0.0274 (WTMT) + 0.8036 (VMAX) + 0.569 (KWING)
23	ENGINE	ML = -0.3960 > 0.0467 (THRUST) + 0.3414 (ENGCITY)
24	AUXILIARY POWER PLANT	MI = 0.192 (KAPU)
29	POWER PLANT INSTL	MI = -0.0943 + 0.0059 (THRUST) + 0.1174 (ENGQTY)
41	AIR-CONDITIONING	MI = -0.0717 + 0.0103 (WTMT) + 0.0364 (WTAVIN) + 0.166 (KBLC)
42	ELECTRICAL	MI = -0.1419 + 0.0259 (WTMT) -0.0485 (GENKVA)
44	LIGHTING	MI = -0.2305 + 0.1652 (WAREA) +0.6472 (FUSILEN)
45	HYDRAULICS	MI = -0.1260 + 0.0066 (WTMT) + 0.3671 (VMAX)
46	FUEL	MI + -0.2947 + 0.1148 (FUEL) + 0.6060 (VMAX)
47	OXYGEN	MI * 0.034
49	MISC UTILITIES	MI =0.0275 + 0.0028 (WTMT)
51	INSTRUMENTS	MI = ().0465 + 0.2906 (WTAVUN)
56	FLIGHT REFERENCE	MI = -0.0890 + 0.2182 (WTAVIN)
57	INTEG GUID/FLT CONTROL	MI * -0.3225 + 0.1783 in (WTMT)
60	COMMUNICATIONS	MI = 0.0428 + 0.0104 (WTMT) + 0.0460 (WTAVIN)
71, 72	NAV/WEAPON CONTROL	MI = 1,3541 + 0.8715 in (WTAVUN)
73, 74		
75	WEAPON DELIVERY	MI = -0.1563 + 0.0040 (WTMT) + 0.0367 (PYLQTY) + 0.082 (KGUN)
76	ECM	MI =0.0645 + 0.0104 (WTMT)
90	MISC EQUIPMENTS	MI = 0.0272 -0.0012 (WTMXTO) + 0.0491 (CREW) + 0.014 (KCHUTE)
01	OPERATIONAL SUPPORT	MI = -7.9012 + 5.3533 in (WTMT) - 1.9394 in (SL)
012	SERVICING	MI * 1.3441 + 0.0046 (WTMT) - 0.2573 (SL)
016	TROUBLESHOOT LAUNCH AIRCRAFT	MI =3.3681 + 1 3259 in (WTCOM)
02	CLEANING	MI = 0.188
03C	TURNAROUND/PREFLIGHT	
03D	DAILY/SPECIAL	MI = 2,3571 + 0,0948 (WTMT) 1,1568 (3L)
03G	PHASE	MI = 0.1455 + 0.0186 (WTMY) + 0.2962 (T/W)
03 S	CONDITIONAL	MI =0.4956 + 0.0229 (WTMT) + 0.0224 (DEN)
0 3Z	OTHER	MI = -0.4068 + 0.3538 (FUSWET) + 0.5392 (T/W)
04	CORROSION PREVENTION	MI = -2.6456 + 2.6493 (FUSWET) + 1.5454 (T/W)
05	SHOP SUPPORT	$MI = -0.3510 + 0.3613 \ln (WTMT) + 0.4916 \ln (T/W)$

Figure 3.3 Baseline O Level MMH/FH Estimating Relationships

3.4 FREQUENCY INDEX ESTIMATING RELATIONSHIPS

In addition to the MI equations previously discussed, the MIM uses a second set of estimating relationships called Frequency Index (FI) equations. These equations are used to determine system Class 1 MA/FH at the Organizational level as a function of applicable aircraft design and performance parameters. The same regression techniques used to develop MI equations were used to develop FI equations. An example of the statistical approach for determining a system Frequency Index follows.

3.4.1 Statistical Airframe/Fuselage Maintenance Actions per Flight Hour (MA/FH)

Statistical Airframe/Fuselage MA/FH at the Organizational level is estimated by Equation 3.2. Data used in its derivation and equation results are shown in Table 3.4.

```
FI = -0.2931 + 0.1800 \text{ in (WTMT)} +0.0525 \text{ in (VMAX)}
r = 0.971
S = 0.020
2S = \pm 0.050
```

TABLE 34 AIRFRAME/FUSELAGE ACTUAL AND EQUATION MA/FH

	j		MA/FH				
ACFT	WTMT	XAMV	ACTUAL	EQUATION			
A-4M	10.4	0.537	0.081	0.095			
A-6E	26.0	0.490	0.233	0.200			
A-7E	18.9	0.509	0.283	0.258			
AS-VA	12.0	0.525	0.125	0.120			
E-AJ	30.8	1.230	0.341	0.335			
7. 2. 1	19.8	0.989	0.233	0.243			
F-14A	38.2	1.314	0.371	0.377			
S-3A	25.6	0.410	0.210	0.250			

Figure 3.4 presents a complete list of the system Frequency Index equations. A graphical presentation of each FI equation is presented in Section 5.0. As with the Maintenance Index, the predicted value calculated by each FI equation is a "baseline" estimate.

STD WUC	SYSTEM	FREQUENCY INDEX EQUATIONS
11,12	AIRFRAME, FUSELAGE	FI = -0.2931 + 0.1800 in (WTMT) - 0.0525 in (VMAX)
13	LANDING GEAR	FI = 0.1019 + 0.1850 (KE)
14	FLIGHT CONTROLS	FI = 0.0112 + 0.1183 (VMAX) + 0.022 (KWING)
23	ENGINE	FI = -0.0194 - 0.0023 (THRUST) - 0.0340 (ENGQTY)
24	AUXILIARY POWER PLANT	FL # 0.037 (KAPU)
29	POWER PLANT INSTL	FI = -0.0069 + 0.0023 (THRUST) - 0.0028 (ENGQTY)
41	AIR-CONCITIONING	FI - 0.0019 + 0.0013 (WTMT) + 0.0072(WTAVIN) + 0.016 (KBLC)
42	ELECTRICAL	FI -0.0100 + 0.002? (WTMT) + 0.0092 (GENKVA)
44	LIGHTING	FI = -0.1458 -0.0333 (WAFEA) + 0.4444 (FUSLEN)
45	HYDRAULICS	FL = 0.0191 + 0.0361 (VMAX)
46	FUEL	FI = 0.0056 + 0.0465 (VMAX)
47	OXYGEN	FI = 0.019
49	MISC UTILITIES	FI = -0.0036 + 0.0004 (WTMT)
51	INSTRUMENTS	FI = 0.0360 + 0.0467 (WTAVUN)
56	FLIGHT REFERENCE	Fi = -0.0106 + 0.0483 (WTAVIN)
57	INTEG GUID/FLT CONTROL	FI = 0.0376 + 0.0201 in (WTAVUN)
60	COMMUNICATIONS	FI = 0.0194 + 0.0037 (WTMT) + 0.0190 (WT4VIN)
71, 72	NAV/WEAPON CONTROL	FF - 0.3616 + 0.2379 LN (WTAVUN)
73,74	[
75	WEAPON DELIVERY	FI = -0.0087 + 0.0006 (WTMT) + 0.0034 (PYLQTY) + 0.017 (KGUN)
76	ECM	FL =0.0049 + 0.0016 (WTMT)
90	MISC EQUIPMENTS	Ft = -0.0057 -0.0003 (WTMXTQ) + 0.0267 (CREW) + 0.007 (KCHUTE)
01	OPERATIONAL SUPPORT	FI + 1.8159 + 1.5686 (FUSWET) + 0.4695 (SL)
012	SERVICING	FI = 1.2895 = 0.4381 in (SL) + 0.2970 in (VMAX)
316	TROUBLESHOOT LAUNCH	
	AIRCRAFT	FL = -0.0378 + 0.1339 (WTAVIN: + 0.4677 (Y.W)
02	CLEANING	FI = 0.397
03C	TURNAROUND/PREFLIGHT	F) = 0 5305 + 0 0208 (WTMT) = 0 1353 (SL)
03D	DAILY/SPECIAL	FI = -0.5132 + 0.7166 (FUSWET) + 0.7052 (1.7W)
03 G	PHASE	FI = 0.025
038	CONDITIONAL	FL = -0.3111 + 0.0561 LN (WTMT) + 0.0701 LN (DEN)
93 2	OTHER	FL = - 0.0760 + 0.0245 (T W) + 0.0074 (DEN)
04	CORROSION PREVENTION	FI = 0 3948 + 0 3100 in (FUSWET)
05	SHOP SUPPORT	FI *0.0316 + 0.0131 (WTMT) + 0.1675 (T.W)

Figure 3.4 Baseline & Level MA/FH Estimating Relationships

3.5 MODEL OPERATION

The Maintainability Index Model (MIM) is a mathematical tool for estimating maintenance requirements for a new weapon system. Execution of the MIM is accomplished by solving a set of index equations and general mathematical relationships. Inputs include applicable aircraft design characteristics, system constants and contractor predictions. Outputs include MMH/FH, MA/FH, MEM/MA, EMT/MA at 0 and I levels for a 3-M (Class 1) and FSE (Class 3) environment. A logic flow diagram depicting the operation of the MIM is shown in Figure 3.1. A discussion on model operation follows.

3.5.1 Aircraft Design and Performance Parameters

As the physical size, performance and capability of a weapon system varies, so does its maintenance requirements. The MIM is built around a set of 27 aircraft parameters that were determined to be the primary design characteristics that effect aircraft maintenance. In addition, values for these parameters are readily available during conceptual and development design phases. Table 3.5 presents a list of those parameters along with F-18A predicted values used as an example.

Table 3.5 Aircraft Parameters

SYMBOL	AIRCRAFT PARAMETERS	F-18A EXAMPLE
FUSWET	Area, Fuselage Wetted - 10 ³ feet ²	0.840
WAREA	Area, Wing 103 feet2	0.390
KAPU	Auxiliary Power Unit Factor*	1
KBLC	Soundary Layer Control Factor*	Э
CREW	Crew Size	1
DEN	Density (WTMT + FUSVOL) - Ib/feet3	18 510
KCHUTE	Drag Chute Factor*	, o
FUEL	Fuel Capacity, Internal ~ 10 ³ gal.	1.615
GENKVA	Generator Electrical Power = 102 KVA	0.80
KGUN	Gun Factor*	1
KE	Kinetic Energy (WTLAND x VMIN2) = 109 b-knots2	0.348
FUSLEN	Length, Fuselage - 10 ² feet	0.56
ENGQTY	Number of Engares	2
PYLOTY	Number of Pylons	9
SL	Soine Length - br	1.35
VMAX	Speed, Maximum at Attitude = 103 knors	1.085
VIAIN	Speed, Minimum Carrier Approach 10 ⁻³ knots	0.130
THRUST	Thrust per Engine - 103 lb	16.000
T/W	Thrust/Weight Har o	1 555
FUSVOL	Volume Essetage - 103 teg. T	1.112
WTAVIN	Weight, Avianics Costalled = 10-16	1 293
WITAVUN	Weight, Avionics Uninstalled 104 its	1 060
WTCOM	Weight, Combat = 103 %	33.600
WTMT	Weight, Empty = 103 %	20 593
WTLAND	Weight, Landing Clean + 10 ³ b	23.083
WTMXTO	Weight Maximum Takenit - 103 is	50 064
KWING	Ning Silveo Factor	U

THE APPLICABLE OFF NOT

The first step in analyzing the maintenance requirements of a weapon system is to complete a worksheet for the weapon system under consideration, similar to Table 3.5, using the aircraft parameters cited therein. After that, maintenance estimates (baseline and predicted) for each system can be determined using techniques presented in Section 5.0.

3.5.2 System Constants

Class 1 O-level MMH/FH and MA/FH are the two maintainability parameters determined through regression analysis techniques. The remaining parameters are calculated using general mathematical relationships and system constants where regression analysis techniques were considered but rejected because of invalid correlation results and to minimize handbook complexity.

System constants are averages based on historical maintenance data concerning past performance. "...The assumption is made that the elemental activities for a new system will closely resemble the systems for which data was collected" That is, if a given system averages 1.5 Men per Maintenance Action, then the same number of men will be required for the new system. Exceptions require maintainability documentation. Definitions of system constants plus sample calculations follow.

Manning Radio (MR) is defined as the average number of men required per unscheduled maintenance action. For each system, a Class 1 MR is determined by averaging individual aircraft Class 1 MEN per Equation 3.3.

$$MR = \sum_{i=1}^{n} MEN_1$$
Eq. 3.3

where,

MR = Average number of men per maintenance action per given system

MEN = Average number of men per maintenance action per aircraft

n = Number of aircraft used in the regression analysis

 $i = 1, 2, 3, \dots, n$

Class 1 MR is used in the MIM to determine EMT/MA for a new aircraft as shown by Equation $3.4\,$

Eq. 3.4

Maintenance Index I-Level Ratio (MIIR) is defined as the ratio of I-level MMH/FH to O-level MMH/FH. Individual aircraft MIIR's are summed and averaged as shown in Equation 3.5.

$$\sum_{i=1}^{n} \frac{MMH/FH_{i}}{MMH/FH_{G}}$$
MIIR =
$$\frac{n}{n}$$
Eq. 3.5

^{4.} D. D. Gregor, Donna F. Harmon, Patricia A. Pate, "Maintainability Estimating Relationships", p.20.

where,

MMH/FH_O = MMH/FH at O level MMH/FH_T = MMH/FH at I level

Using the Airframe/Fuselage System (Table 3.6) as an example, Class ! MIIR was calculated as follows:

= 0.04

Class 1 MIIR is used in the MIM to determine I-level MMH/FH for a new system design as shown by Equation 3.6.

$$MMH/FH_I = MMH/FH_O X MIIR$$

Eq. 3.6

Frequency Index I Level Ratio (FIIR) is defined as the ratio of I-level MA/FH to O-level MA/FH. Individual FIIR's for each aircraft are summed and averaged per Equation 3.7.

$$\sum_{i=1}^{n} \frac{MA/FH_{I}}{MA/FI_{O} i}$$
Eq. 3.7

Using the Airframe/Fuselage System as an example, Class 1 FIIR was calculated to be 0.07.

Class 1 FIIR is used in the MIM to determine I-level MA/FH for a new system using Equation $3.\delta.$

MA/FHT = MA/FHO X FIIR

1.2

Eq. 3.3

TABLE 3.6 TWO-DIGIT WUC MAINTENANCE DATA SUMMARY

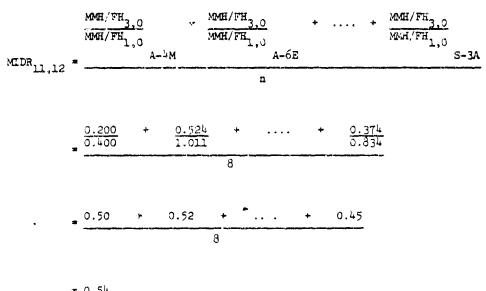
11, 12 SYSTEM: Airframe and Fuselage

	TOTAL	MMI/FH	1.054	1,222	. 746	1.585	2.123	.884		.219	B.	.718	.428	1.196	577.	170.	.45/
		MEN	ر س بر		<u></u>	×	9.	ري ا		1.3	4.	9.	•	2.0	• •	٠. د.	1.4
		EHT/MA	3.43	13.02	0.93	4.12 5.35	9.86	3.13						2.35			
	I LEVEL	HMII/KA	•	21.57	1.68	7.33 5.73			I.	3.13	4.63	15.32	1.35	4.76	3.94	9.23	3.06
馬		MA/FH	.005	.007	.003	00.0	.014	10.	DESIGN EQUIVALENT	, 005	900.	900.	.003	900.	4.0.	.013	
HAINTENANCE -		MMI/FII	.022	151	.005	.044	.221	.050	- DESTON	.015	.028	.092	. 004	.028	cco.	. 120	.034
		MEN	1.8		<u></u>	8	2:1	8.	3 MAINTENANCE	2.0	5.	2.1	8.	<u>۔</u> ﴿	2.3	2.2	<u>د</u> .
CLASS		EHT/HA	2.73	2.36	3.53	3.43 0.43	2.48	2.14	CLASS 3 MAI	1.90	•	•	•	2.15	•	1.10	.35
	O LEVEL	HWI/HA				6.09		•	ט	1 .		*	-	60.	•	•	2.00
		HA/FH	180.	.233	.125	.341	371	.210		.054	.226	.200	.100	.284	. 204	.273	. 165
		May/FH	.400	170		075	·	4		. 203	. 554	.625	. 424	1.161		196.	. 424
	ACT		A4H	Abe A-7F	AVBA		F14A	S3A		A4H	AGE	AZE	AVBA	F4.J		F14A	S3A

Maintenance Index Defect Ratio (MIDR) is defined as the ratio of Class 3 0-level MMH/FH to Class 1 O-level MMH/FH. It identifies that portion of Class 1 maintenauce considered contractor controllable through design. A MIDR is determined for each system by summing and averaging the individual aircraft MIDR's per Equation 3.9.

$$\frac{\sum_{i=1}^{n} \frac{\text{Class 3 O-Level MMH/FH}}{\text{Class 1 O-Level MMH/FH}}}{\text{Eq. 3.9}}$$

Using the Airframe/Fuselage System (Table 3.6) as an example, MIDR was calculated as follows:



***** 0.54

The MIDR is used to determine the Design Maintenance Index scale for the MI graphs of Section 5.0.

Frequency Index Defect Ratio (FIDR) is defined as the ratio of Class 3 0-level MA/FH to Class 1 0-level MA/FH. It identifies that portion of Class 1 maintenance actions classified as Design Induced Malfunctions. A FIDR is determined for each system by summing and averaging individual aircraft FIDR's per Equation 3.10.

$$\sum_{i=1}^{n} \frac{\text{Clase 3 O-Level MA/FH}}{\text{Class 1 O-Level MA/FH}}$$
FIDR =
$$\frac{1}{n}$$
Eq. 3.10

Using the Airframe/Fuselage System as an example, FIDR was calculated to be 0.79. This means that 79% of the reported 3-M data is considered contractor controllable through design. The remaining 21% is primarily attributed to no defect, cannibalization and missing fastener maintenance actions and is considered Navy controllable. The FIDR is used to determine the design Frequency Index scale for the FI graphs of Section 5.0.

3.5.3 Technology Improvement Index

"Maintainability estimating techniques must be responsive to design technology advancements as well as design parameters and historical maintenance data". The MIM calculates baseline maintenance requirements reflecting state-of-the-art technology and its corresponding R&M effort. The model is also receptive to advances in design technology. Inherently, an increase in aircraft performance results in an increase in maintenance requirements. To minimize or reverse this trend, greater emphasis must be placed on R&M through technology improvements. This relationship is shown in Figure 3.5.

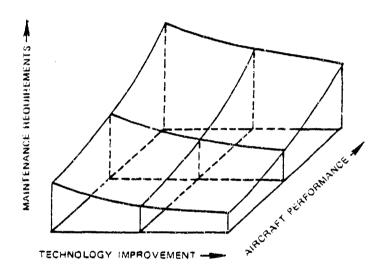


Figure 3.5 Maintenance Requirements (Ref. 10)

Engineering improvements which reduce maintenance resources and frequency of maintenance in a new design are measured by the Technology Index (TI). Using data from the MIM and predictions made by the contractor, a Technology Index can be calculated for each system per Equation 3.11.

$$TI = \left| \frac{\text{EMMH/FH} - \text{PMMH/FH}}{\text{BMMH/FH}} \right| \times 100\%$$

where,

TI = Technology Improvement Index PMMH/FH = Predicted MMH/FH BMMH/FH = Baseline MMH/FH

5. <u>Idem.</u>, p.23.

Using the Airframe/Fuselage System as an example, Class 1 0-level MMH/FH Technology Index for the F-18A was found to be 53%.

$$TI = 1.572 - 0.746 \times 100\% = 53\%$$

where 0.746 is the 3-M equivalent MMH/FH of the contractor's predicted 0.403 value. (Refer to Section 5.0, paragraph 5.1.3 for additional information.) This indicates that the contractor predicts the F-18A Airframe/Fuselage System to be 53% better than a comparable state-of-the-art design. Substantiating documentation for achieving this prediction should be presented through qualitative maintainability features in the contractor's proposal.

Technology Indexes for MA/FH, EMT/MA and MMH/MA are determined in similar fashion and are discussed in Section 5.0, paragraph 5.1.3.

3.6 MODEL VALIDATION

The purpose of the MIM is to letermine the maintenance requirements for a given sized aircraft as a function of design. The model was designed to be independent of system maintenance peculiarities unique to a given aircraft. Ground rules for a system regression analysis permitted excluding those aircraft which exhibited abnormal maintenance. If a satisfactory regression analysis could not be obtained using all eight aircraft, those aircraft in the minority were deleted from the system analysis. To include them would have distorted the trend for a majority of the aircraft, lowered system regression correlation and decreased the effectiveness of the model. The relationship between design and maintenance would be degraded.

An effort was made to determine why certain aircraft exhibited higher or lower reported maintenance than the resultant calculated value. These findings are noted in Section 5.0 when available. Unfortunately, not all cases could be resolved because of insufficient data.

Validation of the MIM was made at both the system and weapon system level using the parameters MMH/FH, MA/FH and EMT/MA. Individual system validation is presented in Section 5.0 by two-digit WUC. Most all systems exhibited correlation coefficients in the high 90's indicating excellent data correlation. Total weapon system validation is shown in Table 3.7 and Figure 3.6. Results show good correlation between actual and calculated data with the model slightly under predicting baseline aircraft maintenance.

TABLE 3.7 MODEL VALIDATION - CLASS 1 MAINTENANCE

	TO	TAL	UNSCHEDULED O-LEVEL									
AIRCRAFT	MPH	/FH	M941/	F¥	M	/FH	EMT/MA					
VIUCIALI	ACT	CAL	ACT	CAL	ACT	CAL	ACT	CAL				
A-4M	14.8	14.6	4.1	4.2	1.0	1.0	2.1	2.1				
A-6E	29.7	30.2	8.5	9.1	2.0	1.9	2.2	2.4				
A-7E	25.0	23.2	7.2	7.0	1.6	1.5	2.2	2.3				
A8-VA	23.1	20.1	6.4	4,8	1.4	1.1	2.4	2.2				
F-4J	40.7	38.3	14.2	12.6	2.4	2.3	3.0	2.7				
F-8J	35.3	26.4	10.4	8.1	2.0	1.5	2.6	2.6				
F-14A	52.2	45,7	18.2	15.1	2.9	2.7	2.6	2.9				
S3A	28.0	30.5	9.8	10.4	2.5	2.3	2.2	2.3				

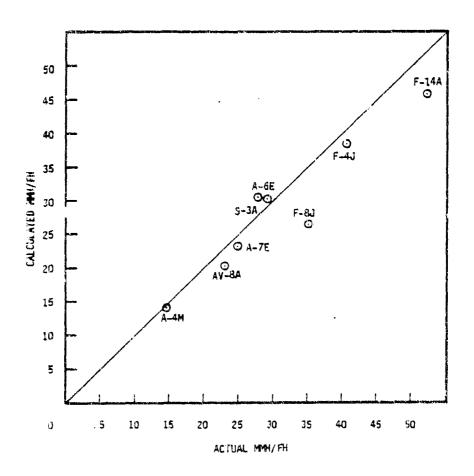


FIGURE 3.5 MODEL VALIDATION - CLASS 1 TOTAL AIRCRAFT MMH/FH

5.0 SYSTEM ANALYSIS

This section of the Handbook presents the methodology and techniques used to evaluate a contractor's quantitative maintainability predictions at the two-digit WUC level. In addition, the user can apply these techniques to establish system goals and total weapon system requirements by specifying desired design technology improvements.

The Handbook is arranged numerically with Standard Work Unit Codes 11-90 identifying aircraft systems and Standard Support Action Codes 01-05 identifying support action tasks. For the sake of continuity, the term system is defined to include support action tasks and the term WUC is defined to include Support Action Codes.

The methodology used to evaluate the maintenance requirements of a new weapon system encompasses using historical data, regression analysis techniques, graphical techniques, contractor predictions and an evaluation worksheet. For each system, a series of tables and figures consistent in title and numbering are presented. To aid in understanding the methodology prasented, the F-18A contractor predictions (Reference 8) are included as an example. Where F-18A predictions are not available (i.e. support actions), baseline values are shown. A brief discussion on the content of the tables, graphs and worksheet follows. Refer to the Airframe/Fuselage System, paragraph 5.1, for sample formats and a more detailed explanation.

TWO-DIGIT WUC MAINTENANCE DATA SUMMARY (TABLE 5.1-1)

This table contains historical maintenance data extracted from Appendix A and used in the system analysis. Data is broken down into two classes of maintenance and two levels of maintenance for five parameters. All total, 22 quantitative values are shown which describe the basic maintenance requirements of these aircraft. When the two-digit evaluation for a new system is completed, the information provided in this section will enable its user to generate a similar set of values.

D REGRESSION ANALYSIS SUMMARY (TABLE 5.1-2)

This table summarizes the results of a regression analysis program used to correlate aircraft design and performance characteristics with historical maintenance data. For each system, or group of systems, one or two applicable design/performance parameters were correlated with Class 1 O-level MMH/FH (Maintenance Index). A similar treatment was performed for Class 1 O-level MA/FH (Frequency Index). Statistical parameter results are included for each index equation.

o SYSTEM MAINTENANCE INDEX GRAPH (FIGURE 5.1-1)

The Maintenance Index (MI) graph shows the relationship between baseline and predicted O-level MMH/FH requirements for a given design. The baseline curve was developed from the regression equation presented in Table 5.1-2 using graphical techniques. The advantage of the graph is that it converts an abstract equation into an easy to understand visual picture. The sensitivity of system maintenance is shown as a function of aircraft speed, weight, thrust, Each graph has two MMH/FH scales. The upper scale called Design MI identifies Class 3 maintenance. The lower scale called 3-M MI identifies Class 1 maintenance. Conversion between the two scales is determined through the Maintenance Index Defect Ratio which is unique for each system. Solution of the graph enables the user to (1) identify the minimum acceptable maintenance expenditure for the given design as measured in an operational environment, (2) convert contractor predicted MMH/FH to a 3-M equivalent and (3) identify the predicted improvement or degradation over a baseline design. See paragraph 5.1.1 for a more detailed explanation on the procedure for evaluating a system Maintenance Index.

o SYSTEM FREQUENCY INDEX GRAPH (FIGURE 5.1-2)

This illustration is similar to the Maintenance Index graph except MA/FH is plotted instead of MMH/FH. See paragraph 5.1.2 for details.

o WORKSHEET FOR EVALUATING SYSTEM MAINTENANCE REQUIREMENTS (FIGURE 5.1-3)

This worksheet is used in evaluating system quantitative maintenance estimates for a new design. To simplify use of the worksheet, it is divided into three parts. Part I calls for RFP response data. From the contractor's maintainability proposal, the user must extract predicted MMH/FH, MA/FH (or MFHBMA) and EMT/MA estimates by two-digit WUC at 0 and I levels. In addition, design/performance parameters applicable to each system are required. To simplify this task, the user may request the contractor submit a list of design/performance parameters (Table 3.5) in his maintainability proposal volume. Part II identifies system constants applicable to each system. Baseline constants were determined from the system historical data base. Predicted constants must be determined using contractor estimates.

Part III of the worksheet presents the system analysis evaluation procedure. The methodology shows how each maintenance parameter can be calculated for baseline and predicted criteria plus identification of technology improvement factors. Full or partial completion of this part of the worksheet is left to the discretion of the Handbook user. All, or just a few parameters can be calculated depending on the depth of analysis equired. See paragraph 5.1.3 for a more detailed procedure on the calculation of system maintenance requirements. The net output from this worksheet will answer the following questions:

- 1. Are the contractor's estimates in the "ballpark"?
- 2. How much maintainability improvement, in percent, is the contractor predicting?
- 3. Do qualitative maintainability features presented in the contractor's proposal substantiate these estimates?

5.22 OPERATIONAL SUPPORT - WUC 01

Selected Parameters: Weight empty, sortie length, and fuselage wetted area.

Number of Regression Equations Run: 7

Parameters Considered and Rejected: Weight combat and weight maximum takeoff.

Comments: Support Action Code 01 accounts for the largest expenditure of reported aircraft maintenance. Approximately 70% of Class 1 Support MMH/FH and 27% of Class 1 Total Aircraft MMH/FH is reported against this code. Operational support is generally considered a Navy responsible task because of the numerous routine and repetitive sub-tasks performed under code 01. OPNAVINST 4790.2A (Ref. 18) does not breakdown code 01 to the 3rd digit. However, a review of the data indicates most commands are using a three-digit code breakdown published by COMNAVAIRPAC (Ref. 31):

Operational Support (010) Ground Handling (011) Servicing (012) Mission Configuration (013) Ground Safety (014)

1...

Manning Standby Aircraft (015)
Troubleshoot Launch Aircraft (016)
Inertial Navigation System (017)
FOD Walkdown (018)
Other (019)

From a contractor's standpoint, only two of these sub-tasks are considered design related: Servicing (012) and Troubleshoot Launch Aircraft (016). Additional data on these sub-tasks is provided in paragraphs 5.22.1 and 5.22.2.

weight empty, sortie length and fuselage wetted area were the design parameters selected by the regression analysis program as having the greatest effect on Operational Support. For the Maintenance Index equation, the relationship was directly proportional to weight empty and inversely proportional to sortie length. For the Frequency Index equation, the relationship was directly proportional to fuselage wetted area and sortie length. Fighter aircraft required more maintenance (support) than attack aircraft because of their design characteristics as illustrated in Figures 5.22-1 and 5.22-2.

The A-7E and F-8J were eliminated from the regression analysis because of unsatisfactory regression correlation. To include them would have distorted the trend for the majority of the aircraft.

Completion of code 01 index graphs requires the user to complete Part I of Figure 5.22-3. Data for this worksheet must be extracted from the Servicing and Troubleshoot Launch Aircraft worksheets.

TABLE 5.22-1 TWO-DIGIT WUC MAINTENANCE DATA SUMMARY

OPERATIONAL SUPPORT SYSTEM: 01 MUC:

	TOTAL	MAH/FH	3.712	8,073	5,523	9.538	11.882	11.457	8,068		906	1.097	1.237	.771	1.002	677.7	1.576
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	O LEVEL	MMH/MA	1.21	2.13	1.53	2.50	2.05	2.12	1.00	10	.57	1.10	1.03	٠٠.	20.	1.04	.96
		MA/FH	3.057	3.754	3.587	3.817	5,793	5.230	4.950		1.586	.993	1.199	•	•	202.2	
		MP4H/FH	3.705	8.012	5.511	9.530	11.873	11.075	7.938		906	1.097	1.23/	1//	7 227	2 127	1.518
	ACFT		A4M	Abt	AV8A	F43	F8J	F14A	53A		A4W	A6E	A/E	AVSA	7 0	F14A	S3A

WUC: 01 SYSTEM: OPERATIONAL SUPPORT

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

ACFT	3	M MI	ERROR	WEIGHT, EMPTY	SORTIE LENGTH				
ACFI	ACTUAL	CALCULATED	ERROR	X 103 LBS (WTMT)	HOURS (SL)				
A4M A6E AV8A F4J F14A S3A	3.705 8.012 5.511 9.530 11.075 7.938	3.785 8.368 5.307 9.823 10.738 7.751	080 356 .204 293 .337 .187	10.4 25.0 12.0 30.8 38.2 26.6	1.550 1.830 1.050 1.380 1.560 2.680				

STATISTICAL PARAMETERS:

REGRESSION EQUATION

MI = -7.9012 + 5.3533 in (WTMT)

-1.9394 In (SL)

CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE

r = 0.9942S = 0.4098

CONFIDENCE LEVEL, 95% NUMBER OF OBSERVATIONS

25 = ±0.8196

Ν = 6

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

ACFT	3	M FI	canan	FUSELAGE WETTED	SORTIE LENGTH
ACFI	ACTUAL	CALCULATED	ERROR	AREA X 103 FT ² (FUSWET)	HOURS (SL)
A4M A6E AV8A F4J F14A S3A	3.057 3.754 3.587 3.817 5.230 4.950	3.308 4.253 3.158 3.896 5.132 4.649	251 499 .429 079 .098 .301	.487 1.006 .541 .913 1.647 1.004	1.550 1.830 1.050 1.380 1.560 2.680

STATISTICAL PARAMETERS:

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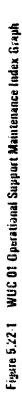
REGRESSION EQUATION FI = 1.8159 + 1.5686 (FUSWET)

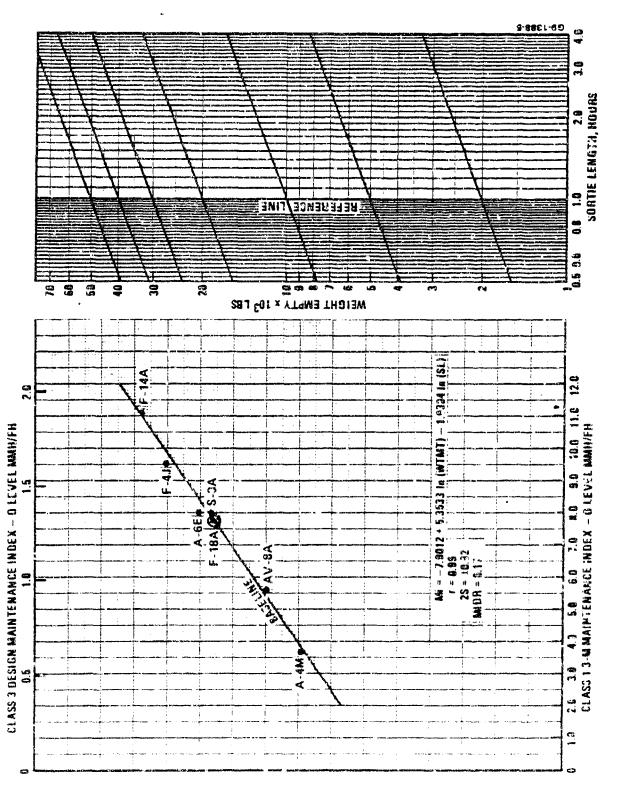
+0.4695 (SL)

CORRELATION COEFFICIENT r = 0.9110
STANDARD ERROR OF ESTIMATE S = 0.6028

CONFIDENCE LEVEL, 95% 2S = ±1.2056 NUMBER OF OBSERVATIONS

N ==





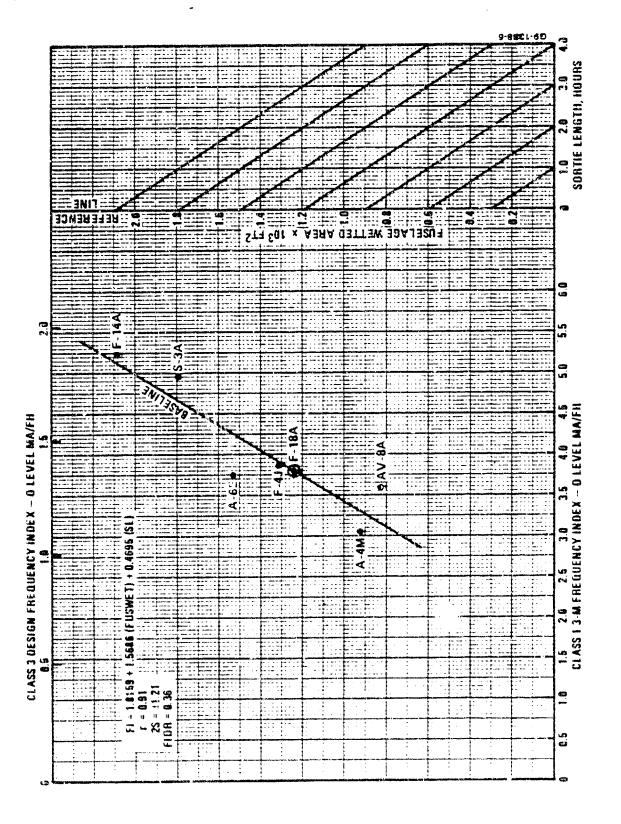


Figure 5.22-2 WUC 01 Operational Support Frequency Index Graph

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(5) MAJFH (6) MMH/MA	X MA/FH X FUR X X MMH/FH = MA/FH = -						
(5) MAJFH (6) NMMH/MA (7)	X MA/FH, X FIIR X						
(5) MAJFH; (6) NMH/MA; (7) EMT/MP;	X MA/FH X FUR X X MMH/FH = MA/FH = -						
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Figure 5.22-3 Worksheet for Evaluating System Maintenance Requirements

5.22.1 SERVICING - WUC 012

Selected Parameters: Weight empty, sortie length, and maximum speed.

Number of Regression Equations Run: 8

Parameters Considered and Rejected: Thrust/weight ratio, weight combat, and weight maximum takeoff.

<u>Comments</u>: Empty weight, sortie length, and maximum speed were the three design parameters selected by the regression analysis program as having the greatest effect on servicing.

Analysis showed that sortie length was a significant driver of servicing maintenance. Index graphs for both MI and FI equations show a negative slope indicating servicing maintenance is inversely proportional to sortie length. Aircraft with higher sortie lengths exhibit lower MI and FI values. For example, doubling the AV-8A sortie length from its current 1.05 hour average to 2.10 hours would reduce the MI 23% and the FI 30%, respectively.

A Maintenance Index Defect Ratio (MIDR) of 0.67 was established based on an analysis of A-7A and F-14A demonstration data. The analysis indicates that 67% of the 3-M reported servicing time is design related. Since all servicing tasks are considered design related, Frequency Index Defect Ratio (FIDR) = 1.0.

The F-8J and F-14A were eliminated from the MI regression analysis because of unsatisfactory regression correlation. For the FI analysis, the F-8J was omitted. Actual MI and FI values exceeded the norm.

.636 .685 .693 .756 .738 .449

TABLE 5,22,1-1 TWO-DIGIT WUC MAINTENANCE DATA SUMMARY

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SERVICING

SYSTEM:

012

MC:

MEN 1 1 1 1 1 1 EMT/MA I LEVEL MMI/MA . 13 . 13 . 13 CLASS 3 MAINTENANCE - DESIGN EQUIVALENT MA/FH ---002 .005 .459 . .002 .005 .459 풄 PANT/FH CLASS 1 HAINTENANCE .002 .001 .230 .088 型 EMT/HA .63 .65 .65 .69 .80 O LEVEI X-1-1-1 94 1.56 1.45 99 91 1.20 1.20 MA/FII 1.010 .655 .713 1.140 1.208 1.461 1.190 1.010 .655 .713 1.146 1.208 1.461 1.190 .712 ##//EH . 536 . 693 . 756 . 737 . 449 . 957 .955 1.022 1.033 1.136 1.100 2.161 1.426 .760 A4M A6E A7E AV8A F4J F14A S5A A4M A6E A7E AV8A F4U F8U F11AA S3A ACFT

MMI/FH

TOTAL

.955 1.022 1.033 1.136 1.102 2.162 2.162 1.656 1.656 WUC: 012 SYSTEM: SERVICING

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

ACFT	3M	MI	ERROR	WEIGHT EMPTY	SORTIE LENGTH
700	ACTUAL	CALCULATED	CAROR	X 10° LBS (WIMT)	HOURS (SL)
A4M A6E A7E AV8A F4J S3A	.955 1.022 1.033 1.136 1.100 .700	.993 .992 .986 1.129 1.130 .776	038 .030 .047 .907 030 016	10.4 26.0 18.9 12.0 30.8 26.6	1.550 1.830 1.730 1.050 1.380 2.680

STATISTICAL PARAMETERS:

REGRESSION EQUATION

MI = 1.3441 + 0.0046 (WTMT)

-0.2573 (SL)

CORRELATION COEFFICIENT

r = 0.9672

STANDARD ERROR OF ESTIMATE CONFIDENCE LEVEL, 95%

\$ = 0.0058 25 = ±0.0116 N = 6

NUMBER OF OBSERVATIONS

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

ACFT	3	M FI	raaan	SORTIE LENGTH	MAXIMUM SPEED X 10 ³ KNOTS
ACFI	ACTUAL	CALCULATED	ERROR	HOURS (SL)	X 10 ³ KNOTS (VMAX)
A4M A6E A7E AV8A F4J F14A S3A	1.010 .655 .713 1.140 1.208 1.190	.913 .813 .847 1.077 1.210 1.176 .593	.097 158 134 .063 002 .014 .119	1.550 1.830 1.730 1.050 1.380 1.560 2.680	.537 .490 .506 .525 1.230 1.314 .410

STATISTICAL PARAMETERS:

REGRESSION EQUATION

3

FI = 1.2895 - 0.4381 ln (SL)

+0.2970 ln (YMAX)

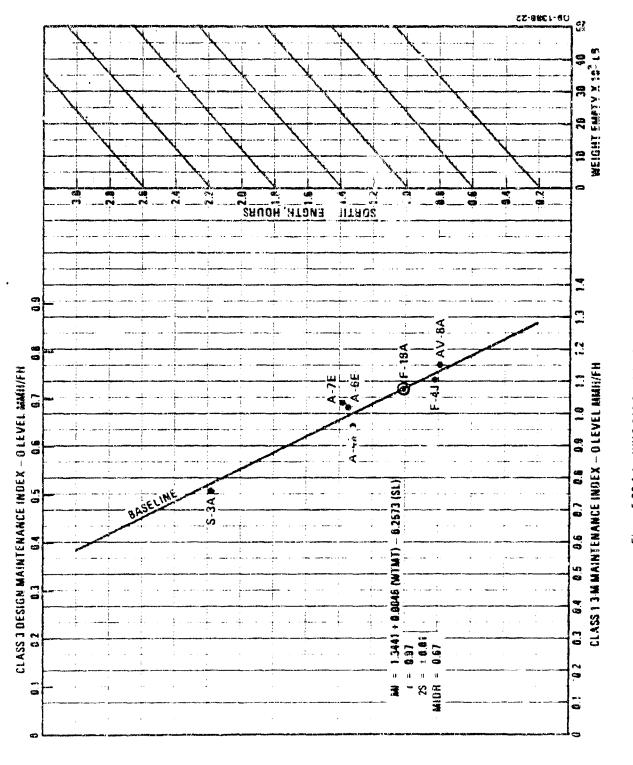
CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE

r = 0.89/5S = 0.0707

STANDARD ERRUR OF LITTUS CONFIDENCE LEVEL, 95%

2S = \$0.1414

N ∞

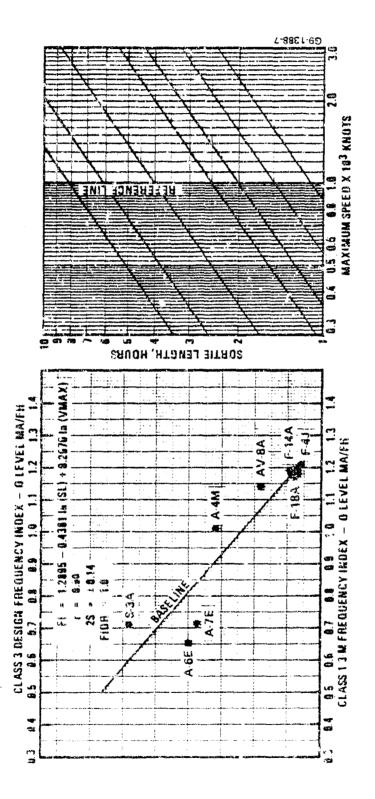


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Figure 5.22.1-1 WUC 012 Servicing Maintenance Index Graph





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MMH/MA	MMH/FH + MA/FH	-111111		MARCHAN (1111, 1111)	A .	}	
HARLINGER HARLING EDWITTE ARRIVES DESCRIPTIONER VAN	MMM/FH = MA/FH			La L	•	Į	
MMH/MA ₁	THE MATERIAL OF THE PROPERTY O					1.7.	
MMH/MA ₁	MMH/FH, T MA/FH,		alabek bandak Universityi	بطدره أسينك بمانسي فالرواء وأسرواه والمواهوطين فعوجه والمواهين أسابها			<u>//</u>
MMH/MA ₁	THE MATERIAL OF THE PROPERTY O		tal dahada badan dada tari pendagangan kanpla dahada dada dakabada dahada mangny segempenyenyenye				7
MMH/MA ₁ (7) EMT/MA ₁	THE MATERIAL OF THE PROPERTY O			بطدره أسينك بمانسي فالرواء وأسرواه والمواهوطين فعوجه والمواهين أسابها			7/

Figure 5.22.1-3 Worksheet for Evaluating System Maintenance Requirements

5.22.2 TROUBLESHOOT LAUNCH AIRCRAFT - WUC 016

Selected Parameters: Weight combat, weight avionics installed, and thrust/weight ratio.

Number of Regression Equations Run: 4

Parameters Considered and Rejected: Weight empty, weight maximum takeoff, and wetted area.

Comments: Support sub-task Troubleshoot Launch Aircraft is considered design related since it is a function of equipment reliability and fault isolation ability. Combat weight, installed avionics weight and thrust/weight ratio were the parameters selected as having the greatest Impact on this task. Regression analysis results are shown in Figures 5.22.2-1 and 5.22.2-2.

The A-6E, AV-8A and F-4J were deleted from the regression analysis because actual MMH/FH and MA/FH values were much lower than calculated values. A correlation between aircraft design and maintenance expenditure was not shown for these aircraft.

TABLE 5.22.2-1 TWO-DIGIT WUC MAINTENANCE DATA SUMMARY

. . ‡

		TOTAL	MMI/FH	.406	.616	.814 .03	395	1,160	1.754	1,513		.270	.412	.544	264	.780	1.173	
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			EHT/MA		ŧ	; ;		1	,	į		·		4 1	1	ı	1 1	
NCH A/C		I LEVEL	MWI/MA		J.	i	j	1.00	4.50	ı		,	ı		ı	.67	3.01	
TROUBLESHOOT LAINCH A/C	풄		MA/FII	-	ı	1 1	,	.002	[3	ı	EQUIVALEN		1	, ,	ı	7005	10. 100.	
TROUBLE	, ,		MME/FH		90.	; 5	ţ	.002	.005	A 517	- DESIGN		į	1 1	ı	.001		
SYSTEM:	CLASS 1 MAINTENANCE			MEN	•	ı	í I	ı	1	ı	ı	NTENANCE	t	7		ð	i	1 ;
s :	CLAS		EMT/MA	ŧ	ì	, ,	1	ţ	ı	,	CLASS 3 MAINTENANCE - DESIGN EQUIVALENT	ı	ı	,	ı	1	1 1	
		O LEVEL	MM!/MA	7.0	1.32	3.28			2.03		ซ	74.		2.20	07.	•	1.16	
016			MA/FH	.576	. 338 486	.007	.379	.801	098,	٠/٥٠		9/5.	339	.007	.379	108.	.873	
MUC:			MWI/FII	406	.615 418	.023	.395	1.158	7,749	1.013		.270	.412	.015	.264	1.70	1.012	
		ACFT		A4M	A6E A7F	AVEA	F4.)	F8J	F19A	KC:		AAM	Abt.	AVBA		F03	S3A	

SYSTEM: TROUBLESHOOT LAUNCH A/C 016 WUC:

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

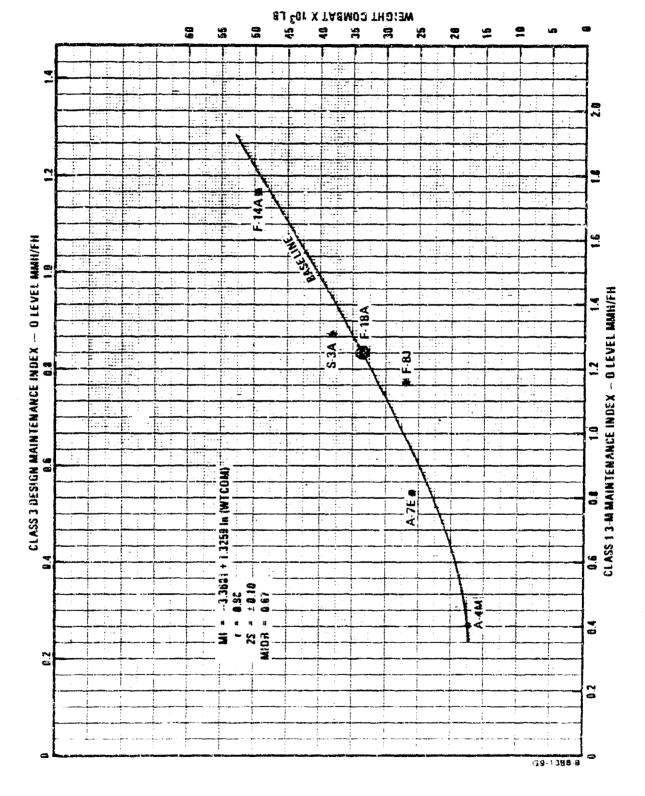
ACFT	ЗМ	MI	ERROR	WEIGHT COMBAT X 103 LBS	·
ACF	ACTUAL	CALCULATED	CAROR	(WTCOM)	
A4M A7E F8J F14A S3A	.406 .814 1.158 1.749 1.513	.434 .947 .992 1.805 1.462	028 133 .166 056 .051	17.6 25.9 26.8 49.5 38.2	
	STATISTICAL PARAMETERS: REGRESSION EQUATION			3.3681 + 1.3259 li	n (WTCOM)
CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE CONFIDENCE LEVEL, 95% NUMBER OF OBSERVATIONS			3 ± 0	0,9773 0,0518 0,1036	

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

3M FI

WEIGHT AVIONICS THRUST/WEIGHT

ACFT	ACTUAL	CALCULATED	ERROR	INSTALLED X 10 LBS (WTAVIN)	RATIO (T/W)
A4M A7E F14A S3A	.576 .486 .860 .873	.547 .513 .881 .854	.029 027 021 .019	.612 1.347 3.039 4.223	1.076 .793 1.094 .697
	STATISTICAL PARAMETERS: REGRESSION EQUATION			0.0378 + 0.1339 (WTA 0.4677 (T/W)	(VIN)
STANC CONFI	LATION COEFF ARD ERROR OF DENCE LEVEL R OF OBSERVA	F ESTIMATE , 95%	S = ±	0.9898 0.0024 0.0043 4	



5-144

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Figure 5.22.2-1 WUC 015 Troubleshoot Launch Aircraft Maintenance Index Graph

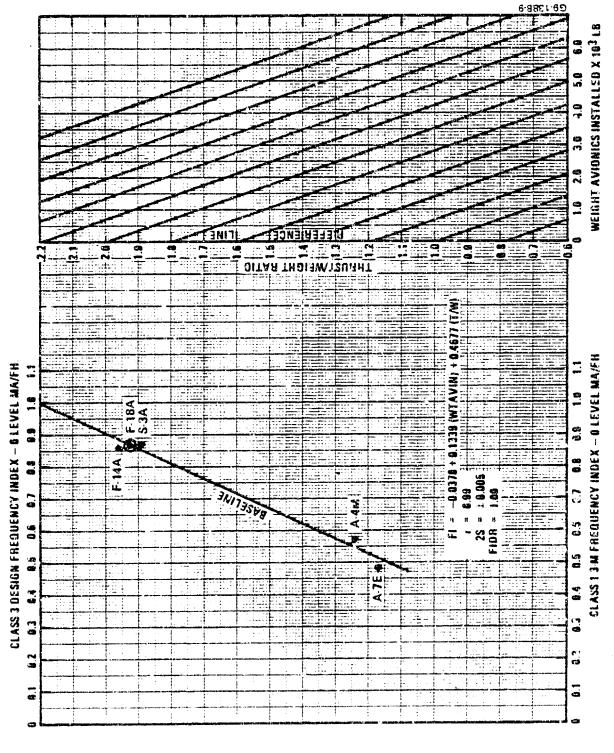


Figure 5.22.2-2 - WUG D16 Troubleshoot Launch Aircraft Frequency Index Graph

A	CIS			CONTRACTOR:_	The Residence of the State of t		·
YSTEM:	Trubleshoot lauget die			AIRCRAFT MOD			
CONT	CONTRACTOR DATA						
All and April 1984 and an artist of the same and an artist of the same and artist of the sa	s 3 design maint. Aeq. Ma/fh mmh/ma emt	managed i	-	PART II SYS	LEW CONS.	TANIS	-
				PARAMETER		pase	ps
			MENO	AVG NO. MEN -	O LEVEL	10-00 (D	-
			MEN.	AVG NO. MEN -	I LEVEL	VPER-CO	
DESIGNIFERFORMANCE PANAMETERS			MINR	MMH/FH I LEVE	L RATIO	.00	
ight Combat, :	lbs. Installed, lbs.		FIIR	MA/PHILEVEL	PATIO	,00	
		BASEI	LINE SS 1	ANALYSIS PREDICTED CLASS 1		JVEMENT (ADATION)	
PARAMETER	CALCULATION	3-M D		3-M DATA (8)	7	<u> </u>	
MMH/FN _O	MAINT, INDEX GRAPH	111111111					
,	BASELINE				1		-
(1)	PMCDICTED						
MA/FHG	FREG. INDEX GRAPM						
(2)	BASELINE		anderske des l'astronites		1	}	
	PAEDICTED				**********	<u>, , , , , , , , , , , , , , , , , , , </u>	-
MMH/MAO	MMH/FHO - MA/FHO					<u> </u>	
	±				1		
(33		• •			1	1	
					**************************************	7,77777	بروس در در
(3) EMT/MA _O	+ MENO						
	MMH/MAO + MENO						
EMT/MA _C							
EMT/MA _G	÷ + MMH/FH) X MIR						
EMT/MA _C	÷ ÷ MMH/FH _O X MHR X						
EMT/MA _O (4) MM44/FH ₁ (5)	÷ ÷ · · · · · · · · · · · · · · · · · ·						
EMT/MAG (4) MM4/FH	÷ ÷ ÷ MMM/FH _O × MHR × × MA/FH _O × FIIR						
EMT/MA _O (4) MM44/FH ₁ (5)	÷ ÷ MMH/FH _O X MIF X X MA/FH _O X FIR X						
EMT/MAG (4) MM4/FH (5) MA/FH (6)	÷ ÷ ALLY X CHA/MWM X X ALLA X CHA/MWM X X X						
EMT/MAG (4) MM4/#H (5) MA/#H	÷ ÷ MMH/FH _O X MIF X X MA/FH _O X FIR X						
EMT/MAG (4) MM4/FH (5) MA/FH (6)	÷ ± MMM/FH _Q × MHR × × X MA/FH _Q × FIIR X X MMM/FH ₁ = MA/FH ₁						
EMT/MAG (4) MMH//FH; (5) MA/FH; (6) MMH//SA; (7)	÷ ÷ ÷ * * * * * * * * * * * * * * * *						
EMT/MAG (4) MMH//FH; (5) MA/FH; (6)	÷ ± MMM/FH _Q × MHR × × X MA/FH _Q × FIIR X X MMM/FH ₁ = MA/FH ₁						
EMT/MAG (4) MMH//FH; (5) MA/FH; (6) MMH//SA; (7)	÷ ÷ ÷ * * * * * * * * * * * * * * * *						

Figure 22.2-3 Worksheet for Evaluating System Maintenance Requirements

5.23 CLEANING - WUC G2

Selected Parameters: Index constants were established for Cleaning.

Number of Pearession Equations Run: 0

Parameters Considered and Rejected: None

<u>Comments</u>: Aircraft Cleaning is considered a Navy responsible support action task. Randomness of the data prevented a satisfactory regression analysis from being performed. As a result, index constants were established.

A Maintenance Index of 0.188 MMH/FH was determined by averaging Class 1 0-level MMH/FH. A Frequency Index of 0.097 MA/FH was determined by averaging Class 1 0-level MA/FH. Given these two constants, the remaining Class 1 baseline parameters can be calculated. Results are shown in Figure 5.23-1.

TABLE 5.23-1 TWO-DIGIT MUC MAINTENANCE DATA SUMMARY

CLEANING	
SYSTEM	
020	
MOC:	

	T0TAL	HEMIL/FH	.074	.144	.203	.334	.299	,155 ,220		
		MEN	ı	ì	ì	ı	ı	1 1		
		ENT/MA	¥	ł	, ,	1	ı	1 1		
	I LEVEL	MM1/MA	1.00	5.00	1.36	2.12	.30	3.76		
新		MA/FH	.044	.003	0110	.008	.020	.005 800.	DESIGN EQUIVALENT	
		H3/HW	.044	.015	.015 .015	.017	.00e	.019 .022	- DESTON	APPLICABLE
CLASS 1 MAINTENANCE		MEN	1	ı	1 1	1	ŧ	1 1	NTENANCE	- - NOT APF
CLAS		EMT/MA	ť	1	, ,	ŧ	ı	1 !	CLASS 3 MAINTENANCE	1 1 1 1 1 1 1
	O LEVEL	HWI/WA		1.22		•	•	4.21	CL	
		MA/FH	.029	106	.243	.159	920.	.041		
		MIVE!	.03u	.129	88.	.317	. 293	198		
	ACF		X X	AGE	AVBA	Fåj	FBJ	53A		A4M A6E A7E AVBA I4J F8J F14A S3A

A CO. LANGE TO SHARE THE PARTY OF THE PARTY	2		CONTRACTOR:_			
YSTEM:	Cleaning		AIRCRAFT MOD	EL:	مراعد المراجع المراجع المراجع	
CONT	CONTRACTOR DATA RACTOR PREDICTIONS — 3 DESIGN MAINT, REC.		PART II SYST	EM CONS	TANTS	
	MA/FH MMH/MA EMT	MA				_
			PARAMETER		BASE	9
O#SIGN/P1	ERFORMANCE PARAMETI	MEN O	AVG NO, MEN - AVG NO, MEN - MMH/FH I LEVEL MA/FH I LEVEL F	LEVEL RATIO	.08	
PARAMETER	CALCULATION	PART III SYSTEM BASELINE CLASS 1 3M DATA (A)	PREDICTED CLASS 1 3-M DATA (8)		OVEMENT ADATIONI (C)	
MMH/FH _O	MAINT INDEX GRAPH		XIIIIIIIII			//
- 1	BASELINE	.188		2772777		-
(1)	PREDICTED					
MA/FH _G	FREG. INDEX GRAPH					Z
12:	BASELINE	.097				
	PREDICTED			 	·, ,	
MMH/MA _O	OHEVEN + OHEVHWM	<u> </u>				2
(3)	.138 + .007	1.94				
	÷ 1453		1 ************************************	 277777777 7	<u> </u>	,,,,,
EMT/MAO	MMHIMAO + MENO				<u> </u>	2
(4)	<u> </u>	7777777777777777				
	MMH/FH X MILE		1 ************************************	97977777	1 1000 100	2
MMH/FH		7//////////////////////////////////////	***********	<u> </u>		<u> </u>
(5)	.198 X .38		<u> </u>			
100/21	MA/FHO X FHR					7
MA/FH;		.012		<u> Kalai Kalai Kalai</u> I	<u> </u>	ے۔
(6)	X X		1			
MMH/MA	MMH/FH, - MA.FH		111111111111111111111111111111111111111		111111111	7
	014 - 015	1.25		<u> </u>		
1		the same of the same of the same of	1			
(71	annon maried distribution or an arrangement distribution and a second second distribution of the second second		1			7,
(7)	MANHAMA, - MEN	<u> </u>	7.77.72.72.72.72.72.72.72.72.72.72.72.72			
EMT/MA		متعيمهم والمتحيد والمتحدد				-
(7)	MINHOMA, - MEN	متعيمهم والمتحيد والمتحدد	The second second			

Figure 5.23-1 Worksheet for Evaluating System Maintenance Pequirements

5.24 INSPECTION - WUC 03

Support Action Code (WUC) 03 identifies maintenance expended for scheduled aircraft inspections. A further breakdown to the third and subsequent digit proved to complicated because of the numerous types of inspections reported and the manner in which they were documented. Instead, a grouping of 03 coded data by Type Maintena se Codes was selected:

INSTRUCTION	STANDARD WCC	TYPE MAINT.					
Turnaroune/Preflight	o ଼ ପ	C					
Daily/Special	იეი	D, M, N					
Phase	03 G	G, J, K, P, Q					
Conditiona	038	S					
Other	03%	A, E, F, L, T, U					

5.24.1 TURNAROUND/PREFLIGHT INSPECTION - WUC 030

Selected Parameters: Weight combat, weight empty, and sortie length.

Number of Regression Equations Run: 6

Parameters Considered and Rejected: Weight maximum takeoff

<u>Comments</u>: Turnaround/Preflight Inspection is considered a design related support action task (FIDR = 1.0 and MIDR = 0.67). Data reported under Standard Work Unit Code (SWUC) 03C is grouped by Support Action Code 03 (Inspection) and Type Maintenance Code C (Turnaround, Preflight Inspections).

Regression analysis showed that combat weight, weight empty and sortie length had the greatest effect on this task. As expected, larger aircraft with more surface area required more turnaround and preflight scheduled maintenance.

The A-6E and F-8J were excluded from the FI regression analysis because of low regression correlation. Actual values for both aircraft were about 27% below the norm. Specific reasons for this could not be determined using the data.

ÍABLE 5.24.1-1 TWO-DIGIT WUC MAINTENANCE DATA SUMMARY

MAH/EH .593 .755 .755 .826 .680 .680 .613 .418 .396 .509 .550 .960 .453 .073 TOTAL HE EMT/MA TURNAROUND/PREFLIGHT INSPECTION I LEVEL MANA MA 1.60 1.00 DESIGN EQUITALENT MA/FH 061 - 100 100 .001 .00 .00 .00 ₹. MEI/FI CLASS 1 MAINTENANCE 8.8 ì CLASS 3 MAINTENANCE SYSTEM: 7 EHT/IM O LEVEL MAN/MA 2.69 2.69 11.28 11.28 11.28 11.28 MA/FH . 591 . 600 . 544 . 641 . 069 . . 074 . . 074 .591 .600 .544 .641 .069 .550 .757 03C正三至 .593 1.615 .756 .826 1.428 .679 1.612 396 1,081 569 550 960 960 453 1,072 ALFT A48K A7E A7E A7E F4U F3U F14A S3A A4M A6E A7E AV8A F4U F8U F14A S3A

WuC:

030

SYSTEM: TURNAROUND/PREFLIGHT INSPECTION

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

ACFT	3	M MI	ERROR	WEIGHT COMBAT X 103 LBS	
MUTI	ACTUAL	CALCULATED	LAKOK	(WTCOM)	
A4M A6E A7E AV8A F4J F8J F14A S3A	.593 1.615 .756 .826 1.428 .679 1.612 1.417	.580 .545 .867 .646 1.414 .898 1.683 1.293	.013 .070 111 .180 .014 219 071 .124	17.6 45.5 25.9 19.5 41.7 26.8 49.5 38.2	

STATISTICAL PARAMETERS:

REGRESSION EQUATION

MI = -0.0282 + 0.0346 (WTCOM)

CORRELATION COEFFICIENT

<u>ت</u> ۳ 0.9554 S≖

STANDARD ERRUR OF ESTIMATE CONFIDENCE LEVEL, 95%

0.1188 25 = ±0.2376

NUMBER OF OBSERVATIONS

N = 8

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

ACFT	3	1 FI	ERROR	WEIGHT EMPTY	SORTIE LENGTH
ACFI	ACTUAL	CALCULATED	ERRUR	X 103 LBS (WTMT)	HOURS (SL)
A4M A7E AV8A F4J F14A S3A	.591 .554 .641 1.069 1.074 .757	.537 .690 .638 .985 1.115 .721	.054 136 .003 .084 041 .036	10.4 18.9 12.0 30.8 38.2 26.6	1.550 1.730 1.050 1.380 1.560 2.680

STATISTICAL PARAMETERS:

REGRESSION EQUATION

FI = 0.5305 + 0.0208 (WTMT)

-0.1358 (SL)

CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE

r = 0.9417S = 0.0313

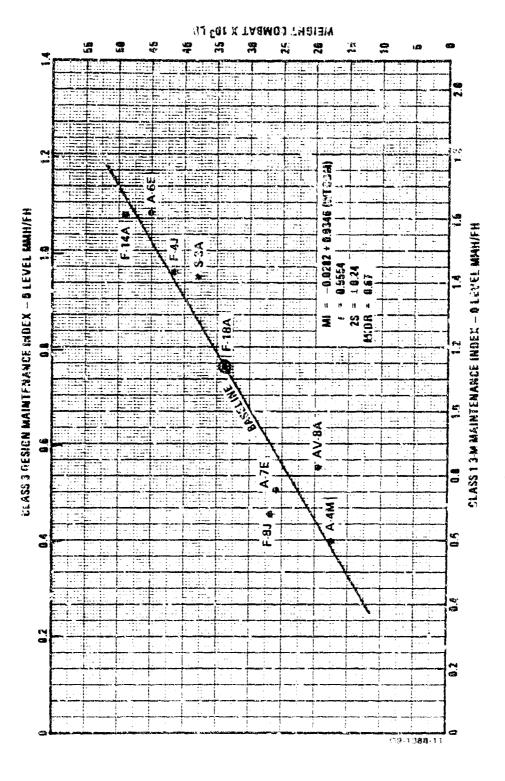
CONFIDENCE LEVEL, 95%

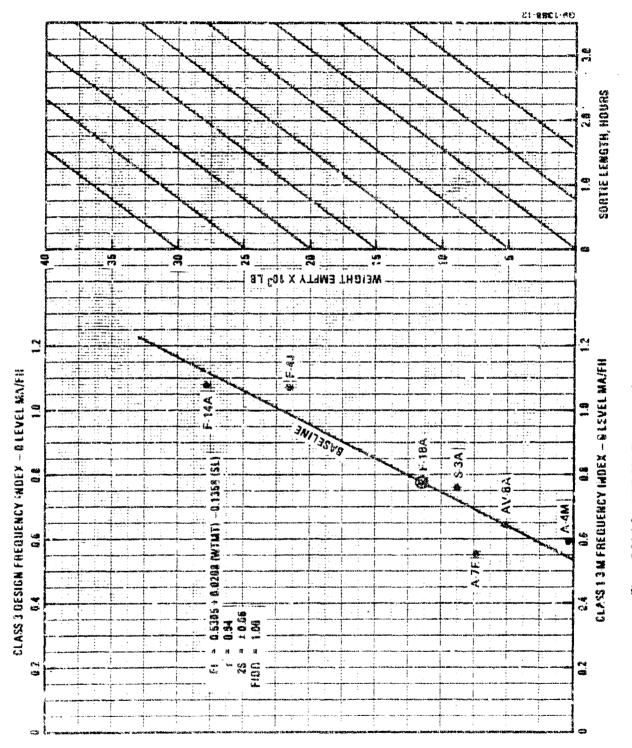
2S = 10.0626

NUMBER OF OBSERVATIONS

N = 6







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Siguro 6.24.1 2 WUC 03C Turnaround, Preflight Inspection Frequency index Graph

/UC:) in the control of t		CONTRACTOR:			ar spirit delication
TO THE PROPERTY OF THE PARTY OF THE PROPERTY OF THE PARTY	CONTRACTOR DATA		Andrews and the second	raine and the state of the stat		independent in
Princip 1, Aprelia Spinato grapo problem presentant	angana taman da mada pinaka katalah dari sa mangali, apri sa manganan da katalah matana.					
-	nactur predictions — 8 3 design mant. Req.		PART II SYST	EM CONS	TANTS	
MANHAHA	MAJEH MMH/"4A EMT.	MA	PARAMETER		BASE	PF
	The second secon	MENQ	AVG NO. MEN -	O LEVEL		
		MEN,	AVG NO. MEN -	i		
		MILE	MMH/FH I LEVEL	RATIO	.00	
OESGN/F	ERFORMANCE PARAMETI	FIIR	MA/FHILEVEL F	RATIO	.00	
ight Empty, 1 rois Langth,	irs.		n ngayanang papanga , maaninahahahahinin kilikatini. Minarini	1994 will 1 0 d ecentables as 17-1800	, po postavi postava postavi postava postavi de la postavi pos	ing to find a spirite of
by primaris A. Managana amenga		PART III SYSTEM		MPR	OVEMENT	
		Basiline Class 1	PREDICTED CLASS 1		(C)	
PARAMETER	CALCULATION	3-M DATA (A)	3-M DATA	7	*	
MMH/FH _O	MAINT, INDEX GRAPH					
	BASELINE	ne - Marchard and and and and a familie relay (*); the extraction of the relay of				
(1)	PREDICTED					
MA/FHO	FREOL INDEX GRAPH					
(2)	BASELINE					
140	PREDICTED				77777	
MMH/MA _O	MMH/FHO + MA/FHO	<i>\$////////////////////////////////////</i>				
139	+					de desirando
EMT/MAD	MMH/MA - MENO					
1			<u> </u>			
(4)				-		-
MMH/FH,	HIM X CHAIHME					
(%)	×			1		
/2/	X			Perlantive interestinate large	ببيجوب برسوس ب	
MA: TH,	MAIFHO X FIIR	<i>3000000000000000000000000000000000000</i>				
(6)	X					
1	X			Serving page (serving)	بسته وسيد رسوه برس	ngunja kamp
The second secon	MMM/FH, - MA/FH					
MNH/MA,				1		
ARRIM/MA,	AND THE PROPERTY OF THE PROPER	manderstander all and collection has designed and collection to the collection of th	. 4	1	}	
MMH/MA,	ANT TO A STATE OF THE STATE OF		4	dodredni vir dretorionimen :	altantaler featherlander sanisa	Market Mark
(7)	IMHAIA, TMEN,					
EMT/MA	AMMONIA, THEN					977
(7)	H TIMHAIA, F MEN					

Figure 5.24.1-3 Worksheat for Evoluting System Maintenance Requirements

5.24.2 DAILY/SPECIAL INSPECTION - WUC 03D

<u>Selected Parameters</u>: Weight empty, sortie length, wetted area, and thrust/weight ratio.

Number of Regression Equations Run: 10

į

Parameters Considered and Rejerrer: Maximum speed, weight combat, and weight maximum takeoff.

Comments: Daily/Special Inspection is considered a design related support action task. All maintenance actions reported against this code are the responsibility of the contractor (FIDR = 1.0), while only 67% of the maintenance time is contractor controllable (MIDR = 0.67). Data reported under SWUC 03D is grouped by Support Action Code 03 (Inspection) and the following Type Maintenance Codes:

- D Daily/Postflight, Daily Special Inspection
- M Hourly Special Aircraft Inspections
- N Cycle/Event Special Aircraft Inspections

The highest maintenance expenditure for scheduled aircraft inspections in this grouping was reported for Daily/Special Inspections. MI values from 1.4 to 4.0 MMH/FH were reported in the data base.

The Maintenance Index regression analysis was found to be directly proportional to weight empty and inversely proportional to sortic length. The Frequency Index equation was found to be directly proportional to fuselage wetted area and thrust/weight ratio.

The A-4M and F-SJ were deleted from the Frequency Index regression analysis because of unsatisfactory correlation. Actual values for both aircraft exceeded calculated values by a factor of two. Average inspection time measured in MMH/MA was much lower for these aircraft than the other aircraft.

TABLE 5.24.2-1 TWO-DIGIT MUC MAINTENANCE SATA SUMMARY

DAILY/SPECIAL INSPECTION SYSTEM: 030 XOC:

CLASS 1 MAINTENANCE - 3M	0 LEVEL TOTAL	V/FH MMH/MA EMT/MA MEN MMH/FH MA/FH MMH/MA EMT/MA MEN MMH/FH	1.04002 .001 1.00 4.44020 .000	3.77001 .003 10.00	3.75003 .001 3.00 - 3.	415 2.85038 .003 12.734.076 797 2.24001 .001 1.00 1.789	CLASS 3 MAINTENANCE - DESIGN EQUIVALENT	383 . 70
CLASS 1 MAINTEN		MEN	1 1		1 1	5 1 1]	
	i i	MA/FH M	1.383 1.689 4	502 3	981	1.415 2 2	J	1.383 .689 .502 1.110 .981 1.660 1.415
	ACFT	MARI/FII	(1)			F14A 4.038 S3A 1.788		A4M . 964 A6E 2.050 A7E 1.268 AV8A 1.606 F4J 2.465 F8J 1.802 F114A 2.702

WUC: 03D

SYSTEM: DAILY/SPECIAL INSPECTION

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

ACFT	ЭМ	MI	ERROR	MEIGHT EMPTY	SORTIE LENGTH
MGC I	ACTUAL	CALCULATED	Cilitor	X 10 ³ LBS (WTMT)	HOURS (SL)
A4M A5E A7E AV8A F4J F8J F14A S3A	1.445 3.061 1.894 2.397 3.678 2.683 4.038 1.788	1.550 2.705 2.148 2.280 3.682 2.662 4.175 1.780	105 .355 254 .116 004 .021 137	10.4 26.0 18.9 12.0 30.8 19.8 38.2 26.6	1.550 1.830 1.730 1.050 1.380 1.360 1.560 2.680

STATISTICAL PARAMETERS:

REGRESSION EQUATION

MI = 2.3571 + 0.0948 (WTMT)

-1.1568 (SL)

CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE

r = 0.9802 S **≖** 0.2348

CONFIDENCE LEVEL, 95%

 $25 = \pm 0.4696$

NUMBER OF OBSERVATIONS

N =

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

ACFT	3.4	FI	ERROR	FUSELAGE WETTED	THRUST/WEIGHT
ACFI	ACTUAL	CALCULATED	ERRUR	AREA X 103 FT ² (FUSWET)	RATIO (T/W)
A6E A7E AV8A F4J F14A S3A	.689 .502 1.110 .981 1.415 .797	.712 .583 1.102 .961 1.439 .698	-,023 081 .008 .020 024 .099	1.006 .749 .541 .913 1.647 1.004	715 93 1./41 1.162 1.094 .697

STATISTICAL PARAMETERS:

REGRESSION EQUATION

FI = -0.5131 + ().7166 (FUSWET)

+0.7052 (T/W)

CORRELATION COEFFICIENT

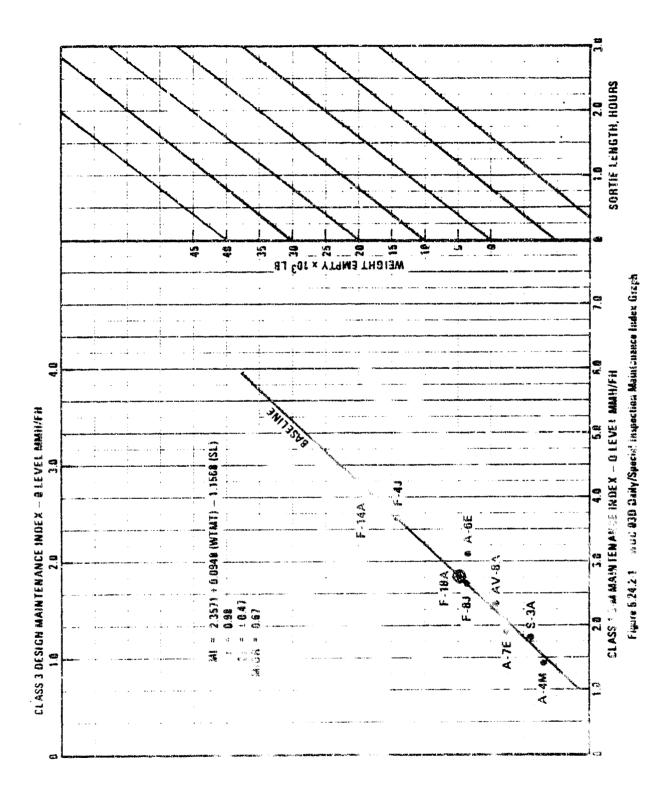
0.9829

STANDARD ERROR OF ESTIMATE CONFIDENCE LEVEL, 95%

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NUMBER OF OBSERVATIONS

/ = 6



5-159

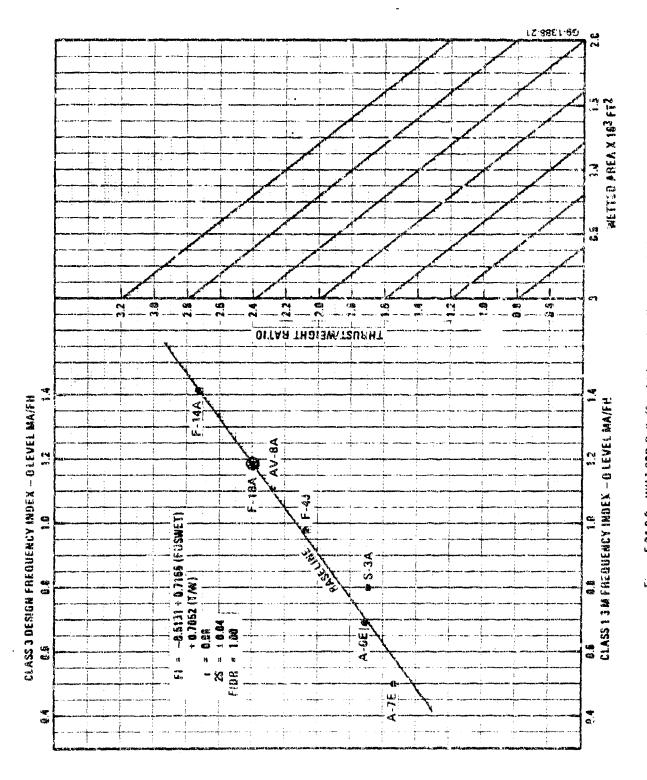


Figure 5.24.2-2. WUG COD Baity/Speciel inspection Frequency Index Graph

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(4) NAME (4) (8) NAME (1) (7)	X X SHR X XMH/FH, Y MA/FH,						

Figure 5.26.2-3 Worksheet for Evaluating System Maintenance Requirements

5.24.3 FHASE INSPECTION - WUC 03G

Selected Parameters: Weight empty and thrust/weight ratio.

Number of Regression Equations Run: 6

<u>Parameters Considered and Rejected</u>: Sortie length, weight combat, density, and weight maximum takeoff.

<u>Comments</u>: Phase Inspection is a design related task addressing the look phase of on-aircraft scheduled maintenance. Data reported under this standard WUC is grouped by Support Action Code 03 (Inspection) and the following Type Maintenance Codes:

G Phased Inspection

1

- J Major Engine Inspection
- K Special Engine Inspection
- P Calendar Odd Inspection
- Q Calendar Even Inspection

Regression analysis for the Maintenance Index equation showed that weight empty and thrust/weight ratio were the most statistically valid design parameters. Larger aircraft with higher thrust engines tend to require more scheduled maintenance.

Two aircraft were deleted from the MI regression analysis for the following reasons. The S-3A was excluded because actual MMH/FH was some 6.% less than the calculated value. Good maintainability design features in the TF-34 engine are noted by an average repair time of less than 15 MMH/MA. The F-8J was excluded because actual MMH/FH was more than twice the calculated value. Excessively high repair time of almost 80 MMH/MA was reported for this older engine.

A Frequency Index constant of 0.025 MA/FH was established by averaging Class 1 O-level MA/FH data. Regression analysis for FI proved unsatisfactory because all aircraft exhibited about the same MA/FH value.

TABLE 5.24.3-1 TWO-DIGIT WUC MAINTENANCE DATA SUMMARY

		TOTAL	H#H/FH	.701 .981 .621 .928 1.166 1.723 1.386		.469 .657 .426 .622 .781 1.153
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			ENT/MA	P. B. B. B. B. B. B. B.		t tire tegg
		1 LEVEL	HE!/MA	1.05 1.00 14.05 51.50 99.00	_	.69 .67 9.38 34.51 66.33
PHASE INSPECTION	£		MA/FH	.001 .001 .002 .002	DESTON EQUIVALENT	.054 .001 .002 .002
PHASE	MAINTENANCE -		H3/imm	.001 .001 .002 .002 .253	- DESTON	.037 .001 .009 .069 .133
SYSTEM:			Fire			
S .	CLASS		EHT/MA		CLASS 3 MAINTENANCE	1 1 1 1 1 1
		O LEVEL	W#H/HA	30.71 39.20 28.88 25.38 44.29 78.22 37.75 14.82	כר [20.58 26.26 19.35 17.01 29.67 52.41 25.29 9.93
036			MA/FH	.021 .025 .026 .036 .024 .022 .023		.021 .025 .022 .036 .024 .022 .030
MUC:			MAIVEII	.645 .980 .980 .621 .914 1.063 1.721 1.133		.432 .657 .426 .612 .712 1.153 .759
		ACFT		A4M A6E A7E AV8A F4J F8J F14A S3A S3A		A4M A6E A7E AV3A F4J F8Q F14A S3A

5-163

SYSTEM: PHASE INSPECTION WUC: 03G

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

\[\(\)	T	3M	MI	ERROR	WEIGHT EMPTY	THRUST/WEIGHT
	, T \	ACTUAL	CALCULATED		X 103 LBS (WTMT)	RAFIO (T/W)
A A	4M 5E 7E V8A 4J 14A	.645 .980 .621 .914 1.063 1.133	.658 .841 .732 .884 1.062 1.180	013 .139 111 .030 .001 047	10.4 26.0 18.9 12.0 30.8 38.2	1.076 .715 .793 1.741 1.162 1.094

STATISTICAL PARAMETERS:

REGRESSION EQUATION

MI = 0.1455 + 0.0186 (WTMT)

+0.2962 (T/W) r = 0.9210

CORRELATION COEFF CIENT

STANDARD ERROR OF ESTIMATE CONFIDENCE LEVEL, 95%

NUMBER OF OBSERVATIONS

S = 0.03492S = ±0.0698

N = 6

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

ACFT	3M	FI	ERROR		
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		УO	T APPLICAB	LE	
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CONF		F ESTIMATE , 95% PTIONS			

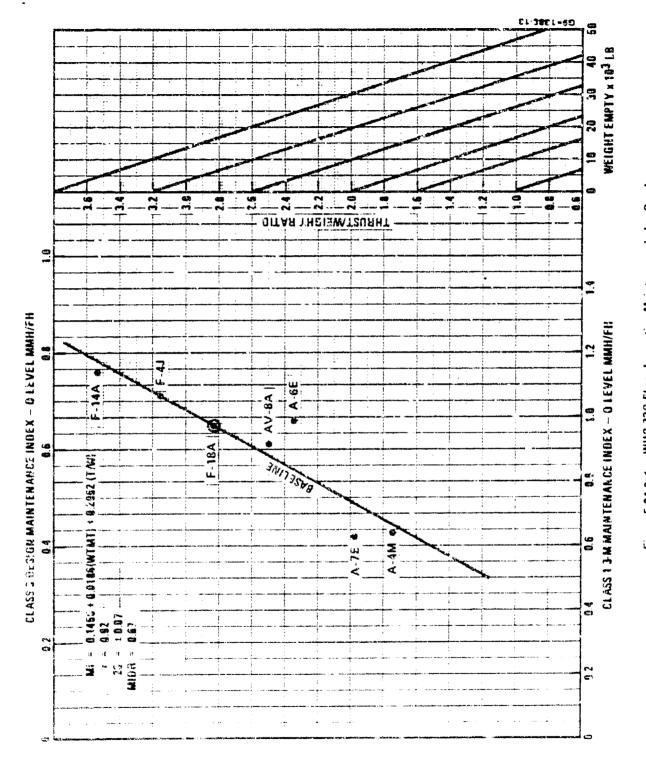


Figure 5.24.3 7 WUE 33G Phase Inspection Maintenance Index Graph

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must/Weight Re						
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(2)	BASELINE			2		
	PREDICTED.					
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MMH/FH	MMH/FH _C X MIIA					11/1
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MA/PH,	MA/FHO X FHR					
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Figure 5.24.3-2 Worksheet for Eval Lung Gester- Maintenance Requirements

5.24.4 CONDITIONAL INSPECTION - WUC 03S

Selected Parameters: Weight empty and density.

Number of Regression Equations Run: 3

Parameters Considered and Rejected: Weight combat and wetted area.

<u>Commerts</u>: Conditional Inspection is considered a design related support action task. All maintenance actions reported against this code are the responsibility of the contractor (FIDR \pm 1.0) while only 67% of the maintenance time is contractor controllable (MIDR \pm 0.67). Data reported under this code is grouped by Support Action Code 03 (Inspection) and Type Maintenance Code S (Conditional Inspection).

Regression analysis for both the Maintenance and Frequency Index equations showed that weight empty and density were the most statistically valid design parameters. Density is defined as weight empty divided by furelage volume.

Variations in conditional inspection tasks between aircraft resulted in a wide dispersal of the data. Certain aircraft were deleted from the regression analysis because to include them would have distorted the trend for the majority of the aircraft.

TABLE 5.24.4-1 TWO-DIGIT WUC MAINTENANCE DATA SUMMARY

O3S SYSTEM: CONDITIONAL INSPECTION

				CLAS	CLASS 1 MAINTENANCE	ENANCE -	÷				
ja san Lindy County ROSE ENGRADISMOLIAN COM			3 LEVEL					I LEVEL			TOTAL
TOTAL MARKET MOTOR	MKUFII .	MA/FII	AT/: AT/	EMT/HA	MEN	H£/HH	MA/FH	HM/HM	EHT/MA	MEN	H3/IBM
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WUC: 03S SYSTEM: CONDITIONAL INSPECTION

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

ACFT	3,4	IMI	ERROR	WEIGHT EMPTY X 103 LBS	DENSITY L8/FT3
AGEI	ACTUAL	CALCULATED		^ (WTMT)	(DEN)
A6E A7E AV8A F4J F14A	.478 .268 .257 .752 .633	.503 .381 .179 .691 .634	025 113 .078 .061 001	26.0 18.9 12.0 30.8 38.2	18.05 19.89 17.91 21.56 11.43
STATIS	I TICAL PARAME	TERS:			THE AMERICAN TO BE A THE REPORT OF FACTOR OF PROPERTY AND AN ACCUSATION OF THE ACCUS

REGRESSION EQUATION

MI = -0.4957 + 0.0229 (WTMT)

+0.0224 (DEN)

CORRELATION COEFFICIENT

STANDARD ERROR OF ESTIMATE

CONFIDENCE LEVEL, 95% NUMBER OF OBSERVATIONS

0.9376 \$:* 0.0232

±0.0464 25 =

N = 5

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

ACFT	3	M FI		WEIGHT, EMPTY	DENSITY
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STATISTICAL PARAMETERS:

REGRESSION EQUATION

FI = -0.3111 - 0.0561 In (WTMT)

+0.0701 In (DEN) 0.9355

CORRELATION COEFFICIENT

S ==

STANDARD ERROR OF ESTIMATE CONFIDENCE LEVEL, 95% NUMBER OF OBSERVATIONS

0.0005 2S = TG.0010

N = 5

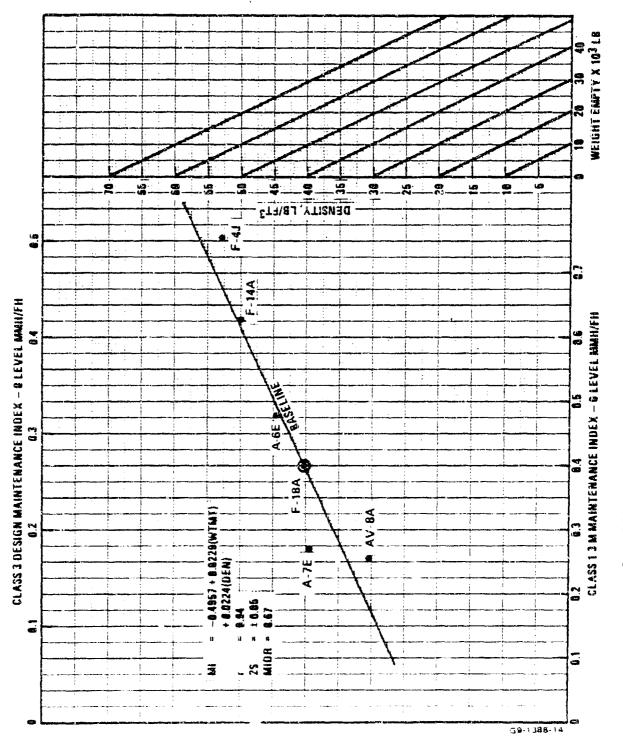


Figure 5.24.4-1 WUC 03S Conditional Inspection Maintenance Index Graph

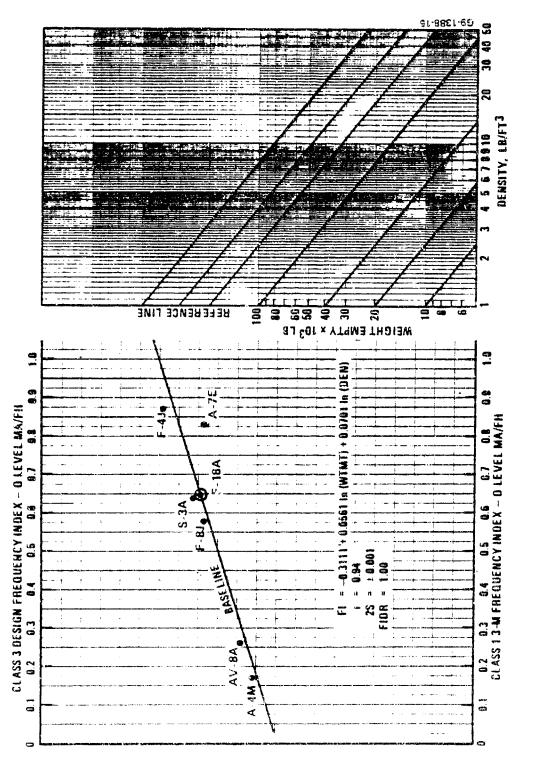


Figure 5.24.4.2 WUC 03S Conditional Inspection Frequency Index Graph

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(3)	MMM/FH ₃ ± MA/	/FH _O							
•		/FH _O							(days at .)
(3)	MMM/FH ₃ ± MA/	/FH _O							
(3)	# + MMH/MH _Q + MA/ + + + + + MMH/MH _Q + ME +	rH _O							<u> </u>
(3)	- MMH/FH _O + MA/ + + + + + + + + + + + + + + + + + + +	rH _O							
(3) EMT/MA _Q (4) MMH/FH ₁	# + MMH/MH _Q + MA/ + + + + + MMH/MH _Q + ME +	rH _O							
(3) EMT/MA _Q (4)	MMH/FH _O + MA/ + + + + + + + + + + + + + + + + + + +	rH _O							
(3) EMT/MA _Q (4) (4) MMH/FH ₁ (5)	# + MMH/FH _O + MA/ # + + + + + + + + + + + + + + + + + + +	FH _O							
(3) EMT/MA _Q (4) (4) MMH/FH ₁ (5)	### ##################################	FH _O							
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Figure 5.24.4-3 Worksheet for Evaluating System Maintenance Requirements

5.24.5 OTHER INSPECTIONS - WUC 03Z

Selected Parameters: Fuselage wetted area, thrust/weight ratio, and density.

Number of Regression Equations Run: 6

Parameters Considered and Rejected: Weight empty, weight combat and weight maximum takeoff.

<u>Comments</u>: Standard WUC 03Z is defined to include those support action inspection tasks that are beyond the control and responsibility of a contractor. All maintenance reported against this code is the responsibility of the Navy (FIDR \approx 0.0, MIDR \approx 0.0). Data reported under SWUC 03Z is grouped by Support Action Code 03 (Inspection) and the following Type Maintenance Codes:

- A General Support
- E Acceptance/Transfer Inspection
- F Transient Maintenance
- L Local Manufacture
- T Supply Support
- U Reclamation and Salvage

Design parameters selected by the regression analysis program emphasized aircraft physical size and performance such as fuselage wetted area, density and thrust-to-weight ratio. Larger aircraft with nigher thrust-to-weight ratios tend to require more miscellaneous scheduled maintenance.

Certain aircraft were deleted from the regression analysis because to include them would have distorted the trend for the majority of the aircraft.

TABLE 5.24.5-1 TWO-DIGIT WIC MAINTENANCE DATA SUMMARY

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OTHER INSPECTIONS	箦		MA/FH	.003	.012	00.8	600	2 (.003	DESIGN EQUIVALENT					<u> </u>	N. ALLEY STREET WHITE
OTHER I	,		M#H/FH	.103	.141	.073	.059	150	.003	- DESIGN		J.F.B 1884		APPLICAPLE	**************************************	Commence
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ADC:			MMI/FII	.375	.301	.710	923.	1,069	.367							
		ACF.		¥.	AGE	AVBA		- C	S3A		A4W	L	AVBA		100 C	

WUC: 03Z SYSTEM: OTHER INSPECTIONS

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

ACFT	3№	MI	ERROR	FUSELAGE WETTED	THRUST/WEIGHT
ACF	ACTUAL	CALCULATED	EAROR .	AREA X 10 ³ FT ² (FUSWET)	RATIO (T/W)
A4M A6C A7E AV8A F4J S3A	.375 .301 .2+5 .710 .559 .367	.346 .335 .286 .723 .543 .324	.029 034 041 013 .616 .043	.487 1.006 ,749 .541 .913 1.004	1.076 .715 .793 1.741 1.162 .697

STATISTICAL PARAMETERS:

REGRESSION EQUATION

MI = -0.4068 + 0.3538 (FUSNET)

+0.5392 (T/W)

CORRELATION COEFFICIENT

STANDARD ERROR OF ESTIMATE CONFIDENCE LEVEL, 95% NUMBER OF OBSERVATIONS

0.9804 * ۴ S = 0.0059 ±0.0118

25 = N ==

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

ACHT	3	M FI	cnacn	THRUST/WEIGHT	DENSITY
ACL MANAGE	ACTUAL.	CALCULATED	ERROR RATIO		LB/FT ³ (OEN)
A6E A7E AYQA F4J S3A	.082 .089 .100 .107 .C46	.074 .090 .038 !11 .051	.008 001 .002 004 005	.715 .793 1.741 1.162 .697	18.05 19.89 17.91 21.55 14.94

STATISTICAL PARAMETERS:

REGRESSION EQUATION

FI * 0.0760 + 0.0245 (T/W)

+0.0074 (DEN)

CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE

CONFIDENCE LEVEL, 95% NUMBER OF DESTRUATIONS

ب ** 0.9767

0.0601 5 ** 2S * ±0.0002

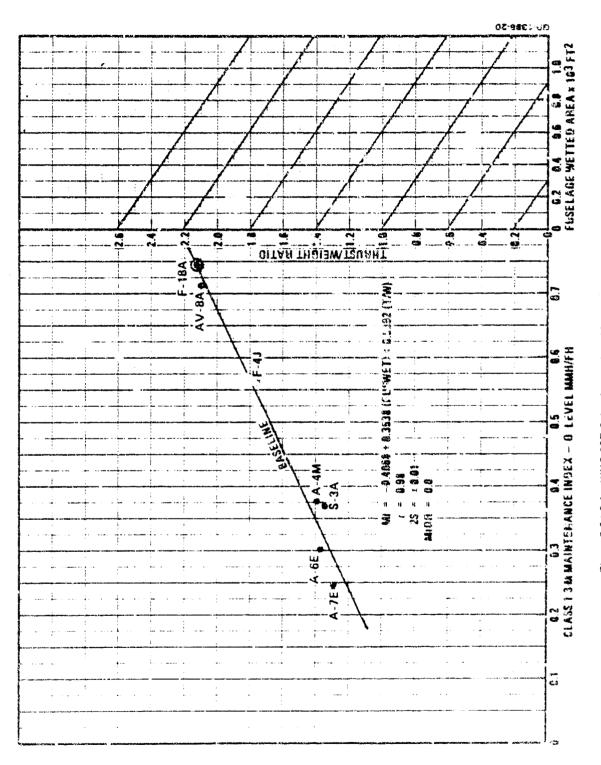


Figure 5.24.5-1. WUS 832 Other inspections Maintengace Index Graph

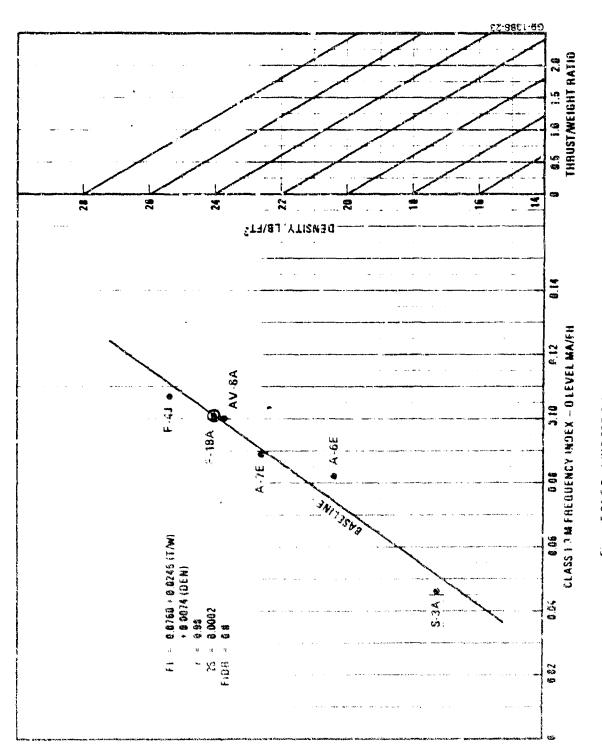


Figure 5.24.5.2 VUC 032 Other lespections Frequency Index Graph

5-177

IC:?	**		CONTRACTOR:			
, <u> </u>	her Instructions		AIRCRAFT MODE	: L:		
CONTR	ONTRACTOR DATA		PART II SYST	EM CONS	TANTS	
	3 DESIGN MAINT. REG. A/FH MMH/MA EMT/	MA	PARAMETER		BASE	PR
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		MEN				1
		MEN	1 i		.16	j
DESIGN/PE	RFORMANCE PARAMETE	IRS BILE	l	1	.07	
selage Wetted rust/Weight Ra Lsity, lb/ft3	Area, ft ^e					
		PART III SYST	PREDICTED CLASS 1 3-M DATA		ROVEMENT HADATION	
PARAMETER	CALCULATION	3-M DATA	3-W DATA (8)	1		Political and a second a second and a second
MMH/FHO	MAINT INDEX GRAPH			\$//////		997
	BASELINE			4		
(*)	PREDICTED			100000	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	77.77
MAJEHO	FREQ. INDEX GRAPH					
(2)	BASELINE	1		4		
\4/	PREDICTED	<i>\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\</i>	///} **********************************	2000000		////
MMH/MA _O	MMH/FHO - MA/FHO	<u> </u>		3 (1/1/1/1)	<u> </u>	
(3)	**	 	<u> </u>	4		
اد ۱ بسیمی <u>مسلم ب</u>	MANAGA - MEN	<u> </u>	(1001) 1997 (1001) (1001)	- 30/1/1/10	02/01/10	1/3/3
EMT/MIA	CNBM - CANHWM			4		كملم المام
(4)				4		
	- 1419			3 10 0 33	12/1/2 13	19/4
	CIMPLES C VILLE					
MMH/FH	MMH/FH _O X MIIR			1		
MMH/FH ₁ (5)	*			4		
(5)	×			 		Zha el
·	X X MAIFH 2 C FIIR				377277	Novi .
(5)	X X MAIFM _D (FIIR X			\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		Novel.
(5) MAJPH, (6)	X X MAIFH 2 C FIIR			2		1940. 1970.
(S) MAJEH,	X X MA/FM ₂ X FIIR X					
(5) MAJPH, (6)	X X MAIFH 2 C FIIR X X X MMHIFH - MAIFH					
(S) MAJPH; (S) MMH/MA; (7)	X X MAIFH 2 C FIIR X X X MMHIFH - MAIFH					9,00
(5) MAJEH, (6) MMH/MA ₁	X X MA(FH) C FIIR X X X MMH(FH) = MA(FH) -					9,00
(S) MAJPH; (S) MMH/MA; (7)	X X MA(FH) C FIIR X X X MMH(FH) = MA(FH) -					9,00

Figure 5.24.5-3 Worksheet for Evaluating System Maintenance Requirements

5.25 CORROSION PREVENTION - WUC 04

Selected Parameters: Fuselage wetted area and thrust/weight ratio.

Number of Regression Equations Run: 9

<u>Parameters Considered and Rejected</u>: Density, weight empty, max speed, weight combat, and weight maximum takeoff.

<u>Comments</u>: Corrosion Prevention is considered a design related support action task. All maintenance actions reported against this code are the responsibility of the contractor (FIDR = 1.0) while only 67% of the maintenance time is contractor controllable (MIDh = 0.67). Data reported under this code is grouped by Support Action Code 04 and all Type Maintenance Codes.

Regression analysis showed that fuselage wetted area and total aircraft thrust-to-weight ratio were the most statistically valid design parameters. Certain aircraft were deleted from the analysis because to include them would have distorted the trend for the majority of the aircraft.

This task is very dependent on aircraft age. New aircraft require less corrosich prevention than older aircraft. A case history study on one type aircraft showed average annual MMH/FH has tripled from the first through the seventh year of operation. A leveling off in MMH/FH was noted on that aircraft about two years after IGC.

TABLE 5.25-1 TWO-DIGIT WUC MAINTENANCE DATA SUMMARY

CORROSION PREVENTION

SYSTEM:

040

WUC:

	EL A EMI/MA MEN MMH/FH 032 032 032 032 030 013	140	771	1.173	.873	1,330	1.037	2,25 <i>/</i> 550	7000										
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			EMT/MA	1	ı	å i		•	ı	ı			t	,	ı	ı	i	i i	
		I LEVEL	MWI/MA	2.91	2.05	.63	1.82	17.	2.07	1.85	1	1.95	1.37	.42	1.43	1.22	86.	1.39	
	1		H4/kH	110.	.040	.048	.028	.014	.027	.007	N EQUIVALEN	110.	.040	.048	.007	820.	.014	700	;
			H##1/FH	.032	.082	.030 015	.051	010.	.056	.013		.021	.055	.020	010.	.034		600.)
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											าว	1.68	3.71	3,53		70.4	3.47	1.76	
			MA/FH	970.	. 193	. 192	.318	.297	.512	.307		920.	.193	.321	361.	750	512	307	
	ACFT		MAI/FH	191	1.069		1,935	•	•	808.		.128	.716	1.153	.003	1.50	2.032	541	
				NA V	ATT	AV8A	FAJ	F8]	₹	SSA		AAM	ا (دیا	A/E	Z	o c	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	. «€ • °°)	

040 WUC: SYSTEM: CORROSION PREVENTION

MAINTENANCE INDEX ESTIMATION - MMH/FH O LEVEL

ACFT	3M	MI	ERROR	FUSELAGE WETTED	THRUST/WEIGHT
701	ACTUAL	CALCULATED		AREA X 103 FT ² (FUSWEY)	RATIO (T/W)
A4M A6E AV8A F4J A8J F14A S3A	.191 1.069 1.290 1.935 1.538 3.314 .808	.308 1.125 1.478 1.569 1.165 3.409 1.091	117 056 188 .366 .373 945 283	.487 1.006 .541 .913 .861 1.647 1.004	1.076 .715 1.741 1.162 .990 1.094 .697

STATISTICAL PARAMETERS:

REGRESSION EQUATION

MI a -2.6456 + 2.6493 (FUSWET)

+1.5454 (T/W)

CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE

0.9642 S = 0.4142 25 * ±0.8284

CONFIDENCE LEVEL, 95% NUMBER OF OBSERVATIONS

N =

γ =

FREQUENCY INDEX ESTIMATION - MA/FH O LEVEL

ACFT	3	M FI	ERROR	FUSELAGE WETTED	
ACFI	ACTUAL CALCULATED		EXRUR	AREA X 10 ³ FT ² (FUSWET)	
A4M A7E AV8A F4J F8J F14A S3A	.076 .321 .192 .318 .297 .512 .307	.125 .259 .158 .321 .303 .506 .351	049 .062 .034 003 006 .006	.487 .749 .541 .913 .861 1.647 1.004	

STATISTICAL PARAMETERS:

REGRESSION EQUATION

FI * 0.3948 + 0.3130 In (FUSWET)

CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE r = 0.9551 S = 0.0094

CONFIDENCE LEVEL, 957

2S * ±0.0188

NUMBER OF OBSERVATIONS

× 1,

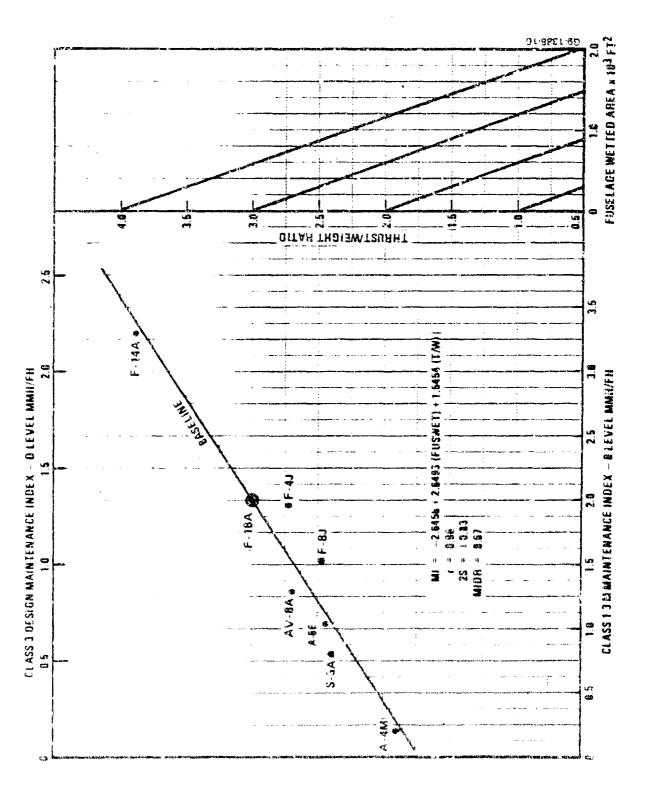
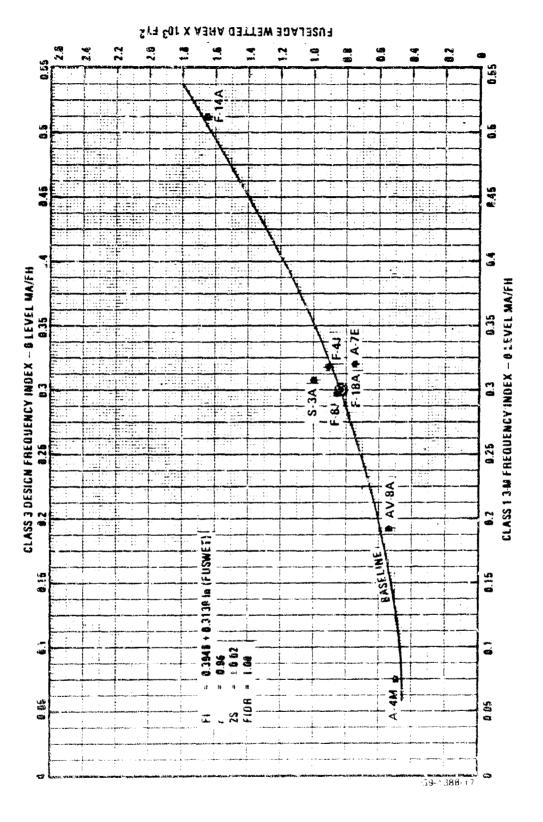


Figure 5.25-1 1977 C 040 Corrosion Prevention Maintenance Index Graph

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Figure 5.25-2 WUC 040 Carrosion Prevention Frequency Index Graph

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	(WARTI)	MAP 123 CHINGS INCOME.	1 / 141 / 1		PARAMETER		BASE	PF
				MENO	AVG NO. MEN -	O LEVEL		
_				MEN,	AVG NO. MEN -	1	***	
	DESIGNAP	ERFORMANCE PARAMET	TERS	MIR	MMH/FH I LEVE	1	•O#	1
131	elage Wetted ust/Weight Ra	Area, ft ²			MA/FH I LEVEL		.09	
	1		8A CI	SELINE LASS I M DATA	PREDICTED CLASS 1 3-M DATA		OVEMENT (ADATION)	
L	PARAMETER	والمراجع المراجع المراجع المراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع		(A)	(8)	<u> </u>	*	many open
	MMH/FHO	MAINT INDEX GRAPH	<u> </u>			X///////		
	145	SASELINE				3		
	(1)	PREDICTED	<u> </u>		4			-
	MA/FH _O	FREQ. INDEX GRAPH	1/////			X///////		
	(2)	BASELINE				1		
	` - '	PREDICTED	V/////		4			
	MMH/MA	VIMHITHO - MAITHO	1/////		X/////////////////////////////////////			
		-				<u> </u>		
	(3)	÷	V//////		4	Ţ		-
	EMT/MA _O	MMH/MA - MENO	V/////			<i>`{}}}}}}</i>		7711
	- 1					2		
Į,	(4)	-		[[]]]]]]]]	3	1		************
-	MMH/FH	RIIN X CHAIHMN	9/////					07/
	· [X				<u> </u>		
	(5)	х	V/////			1 .		
L	MAJ#H	PIIR X CHRIAM	1//////			X////////		7//
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	YMHYMA,			J. Magail, Mills Mills and Magaille				-
1	VIMH/MA ₁]			_		
-	ИМН/МА₍ (7)	No. of the contract of the con	1777		4 <u></u>			
	(7)	UMHOMA - MEN.) {////////////////////////////////////	<u> </u>		4//
3	(7) 3MT/MA ₁	JIMH-MA - MEN.			de la compressión de la compre			
-	(7)	JMH-MA - MEN.		ny transportunity received publically also specifically administrative as to par - coproductive specifically and as				17/1

Figure 5.25-3 Worksheet for Evaluating System Maintenanch Requirements

5.26 SHOP SUPPORT - WUC 05

Selected Parameters: Weight empty, and thrust/weight ratio.

Number of Regression Equations Run: 4

Parameters Considered and Rejected: Weight combat and weight maximum takeoff.

<u>Comments</u>: Standard WUC 05 is defined to include those support action tasks that are beyond the control and responsibility of a contractor. All maintenance reported against this code is the responsibility of the Navy (FIDR \approx 0.0, MIDR \approx 0.0). Data reported under SWUC 05 includes the following support actions:

- 05 General Functions
- 06 Buildup and Teardown/Engine Test Stand Operation
- 07 Mission Shop Support
- 08 Inspection of Aviator's Equipment
- 09 Non-Aeronautical Work

Regression analysis for both the Maintenance and Frequency Index equations showed that weight empty and thrust-to-weight ratio were the most statistically valid design parameters. Certain sub-tasks identified in Ref. 31 were adjusted to the Fleet average to insure a more representative data sample. As shown below, actual MMH/FH values for some aircraft exceeded the norm because of unique maintenance requirements. Adjustments were made by averaging MMH/FH values for the remaining aircraft reporting maintenance data against that given sub-task. A similar adjustment was made for MA/FH.

			CLASS 1 O-LEVEL	ADJUSTED TO
<u>WUC</u>	SUB_TASK	AZC.	HIVHEN	FLEET AVG.
052	Painting	F-8J	.370	.102
057	Test/Inspect/Service	AV-8A	.635	.025
070	Mission Shop Support	F-8J	.58:	. 171
076	Sonobuoys	S-3A	. 130	.000
077	ECM/Chaff	A-4M	.233	.013
078	Tape/Film	A = 141%	.441	.025
090	Non-Aero Work	AV-8A	. 417	.060

TABLE 5.26-1 TWO-DIGIT WUC HAINTENANCE DATA SUMMARY

SHOP SUPPORT

1

	TOTAL	PM4/FH	1.175	969.	2,077	2.412 2.412 .979		
		KĨÑ			1 1	e i e	, and the same of	
		EHT/HA		9 (1	1 1 1		1 1 1 1 1 1 1
	1 LEVEL	HEI/E	4.28	50.2	9	1.63		
壽		MA/FH	153	9	89.	1.424	DESIGN EQUIVALENT	
JUNEAGER			.655 334	35.0	1.036	1,471	- DESIGN	APPLICABLE
series 1		H.	8 8	ß 1	i	l : 1	NTENANCE	MO 1 1 1
SYD		THE PERSON	A STATE OF THE STA	il II	\$ I	1 1 1	CLASS 3 MAINTENANCE	
	1		CA C	600	200	4 10 m	כו	
					0,7	- C C		en e
		Section and	526		1.04.	.941		and the second s
The second second	france	11. 00 mm m m m m m m m m m m m m m m m m		AV 82 mm	7	F14A 53A		* FRESTA A SAC

WUC: ____05

STANDARD ERROR OF ESTIMATE

CONFIDENCE LEVEL, 95% NUMBER OF OBSERVATIONS

SYSTEM:

SHOP SUPPORT

MAINTENANCE INDEX ESTIMATI - MMH/FH O LEVEL

ACFT	3	M MI	ERROR	KEIGHT EMPTY X 103 LBS	THRUST/WEIGHT RATIO (T/W)	
	ACTUAL	CALCULATED	EXMOR	(WTMI)		
A4M A6E A7E AV8A F4J F8J F14A S3A	.520 .608 .606 .812 1.041 .727 .941 .703	.531 .661 .597 .819 .961 .723 1.009 .657	011 053 .009 007 .080 .004 068 .046	10.4 25.0 18.9 12.0 30.8 19.8 38.2 26.6	1.076 .715 .793 1.741 1.162 .990 1.094 .697	
	ICAL PARAM SSION EQUA).3J10 + 0.3613 In).4910 In (T/W)	(WTMT)	

FREQUENCY INCEX ESTIMATION - MA/FH O LEVEL

\$ = 0.0163

±0.0326

8

2S =

N =

ACFT	Ĵ	m fi	ERROR	WEIGHT EMPTY X 103 LBS	THRUST/WEIGHT RATIO (T/W)	
ACT	ACTUAL	CALCULATED	ERRUR	(WTMT)		
A4M A7E AV8A F4J F8J S3A	.312 .364 .411 .590 .341 .429	.285 .349 .417 .567 .394 .434	.027 .015 006 .023 053 005	10.4 18.9 12.0 30.8 19.8 26.6	1.076 .793 1.741 1.162 .990 .697	

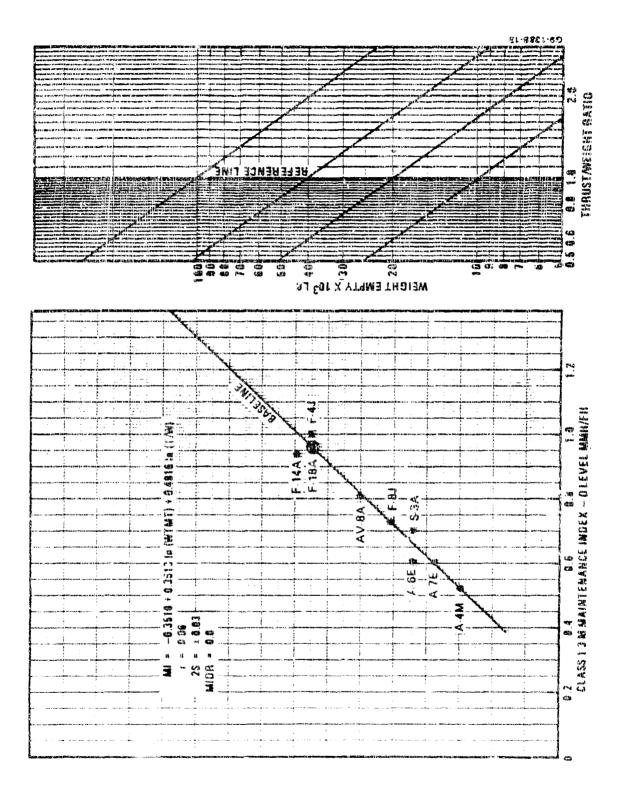
STATISTICAL PARAMETERS: REGRESSION EQUATION

FI = -0.0316 + 0.013 (WTMT) +0.1675 (T/W)

CORRELATION COEFFICIENT STANDARD ERROR OF ESTIMATE CONFIDENCE LEVEL, 95% NUMBER OF OBSERVATIONS

0.9548 0.0043 5 =

2S × t0.0086



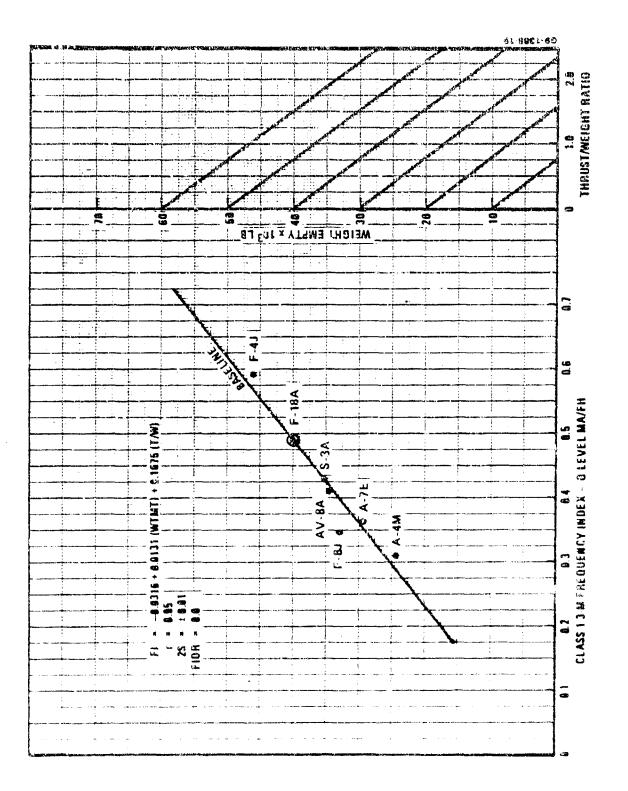


Figure 5.26.2 WUC 05 Shap Support Frequency Index Grapf.

PART I C CONTR CLASS	ONTRACTOR DATA		AIRCRAFT MOD	EL:						
CONTR CLASS					AIRCRAFT MODEL:					
	INCION PARTICITORS -				•					
MMH/FH A	3 DESIGN MAINT. REC.		PART II SYS	TEM CONST	ANTS					
	MA/FH MMH/MA EMT/	MA	PARAMETER		LASE	Pf				
		MEN	AVG NO. MEN -	O LEVEL						
		MEN	AVG NO. MEN -	1	'					
DESIGN/PE	RFORMANCE PARAMETS	IRS MIR	MMH/FH I LEVE	1	.77 .55					
eight Empty, lb hrust/Weight Re	atio									
			EM ANALYSIS	IMPRO	ROVEMENT					
		BASELINE CLASS 1 3-M DATA	CLASS 1	DEGR	(DEGRADATION)					
PARAMETER	CALCULATION	(A)	(B)	 ``````````	2777777	777				
MMH/PHO	MAINT, INDEX GRAPH	40000000		<u> </u>	<u> </u>					
(Y:	8/ASELINE PREDICTED	100000000000000000000000000000000000000		4	1					
	FREQ. INDEX GRAPH			XIIIIIIII	dana.	9//				
MA/FH _O	BASELINE			A		لتصغيب				
(2)	PREDICTED	1//////////////////////////////////////	<i>(1)</i>							
MMH/MA _Q	MMH/FHO - MA/FHO				tirittili.	1997				
(35.		1		4						
	MMH/MA - MEN		99 WYWWW 100	V.17.7.3.1	17/1/20	972				
EMT/MA _O	**************************************	<u> </u>	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	1	4222					
143		17770 17700 1		4						
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	MMH FH X MHR	<u> </u>	the same of the sa							
,	×		40 10 10 10 10 10 10 10 10 10 10 10 10 10							
15)	X			1		-				
MA/FH	MAIR X CHRIAN	V1911111111111111111111111111111111111		<u> </u>	<u> </u>					
(6)	X	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	<u> </u>	4						
	VAHAFH - WALFH			80.000		,				
SMH/MA	_	1	Andreada and a second a second and a second	1		ha fiankrik s				
171	-									
SMT:MA,	TIME VIA SEN			· ·						
3.11	-									
WMH(FHO)	<u> - ММы-яза</u>		A STATE OF THE STA	and following the second secon						

Figure 5.26-3. Worksheet for Evaluating System Maintenance Requirements

- 28. Work Unit Code Manual. U. S. Navy Series P-3 Aircraft. NAVAIR 01-75PA-8. Naval Air Systems Command, U. S. Navy, Washington, D. C., January 15, 1976.
- Work Unit Code Hanual, U. S. Navy Series S-3 Aircraft. NAVAIR 01-S3AA-8. Naval Air Systems Command, U. S. Navy, Washington, D. C., August 1, 1974.
- 30. Work Unit Code Manual. U. S. Navy Series V-8 Aircraft. NAVATR 01-V8-8. Naval Air Systems Command, U. S. Navy, Washington, D. C., December 1, 1975.
- 31. Support Action Codes. COMNAVAIRPACNOTE 4790, 2 November 1972.